Appendix D
Project Description Technical Report (TWE 2012)

TransWest Express Transmission Project

Project Description Technical Report

Submitted by

TRANSWEST EXPRESS LLC

Submitted to

NATIONAL SYSTEM OF PUBLIC LANDS

Wyoming State Office

Western Area Power Administration

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TABLE OF CONTENTS

1.0 INTRODUCTION 1

1.1 PDTR PURPOSE AND SCOPE 1
1.2 DEFINITIONS OF KEY TERMS 1

2.0 TRANSWEST PROPOSED ACTION 3

2.1 TWE PROJECT COMPONENTS 3
2.2 TWE PROJECT LOCATION 3
2.2.1 Regional Vicinity 3
2.2.2 Designated Utility Corridors 5
2.3 TWE PROJECT TECHNICAL REQUIREMENTS 5
2.3.1 NERC Standards and WECC Regional Criteria Guidelines 5
2.3.1.1 Level 1 – Standard Co-Location Distances 6
2.3.1.2 Level 2 – Selective Situations Co-location Distances 8
2.3.1.3 Level 3 – Extreme Situations Co-location Distances 8
2.3.2 Commercial Requirements 9
2.4 TWE PROJECT HISTORY 9
2.4.1 Alternatives Considered Early On (Pre-BLM Application Filings) 9
2.4.1.1 2006-2008 Electrical Transmission System Planning Studies 9
2.4.1.2 2006-2008 Regional Corridor Studies 10
2.4.2 Transmission Corridors and Facility Sites Identified in BLM Application Filings 10
2.4.3 System Alternatives Identified by Applicant 13

3.0 PROJECT DESCRIPTION 14

3.1 TWE PROJECT ±600 KV DC TRANSMISSION LINE 14
3.1.1 Structure Designs 16
3.1.2 Structure Foundations 22
3.1.3 Conductors 22
3.1.4 Insulators and Associated Hardware 23
3.1.5 Overhead Shield (Ground) Wires 24
3.1.6 Grounding Rods 24
3.1.7 Minor Additional Hardware 24
3.1.8 Grid Interconnections 25
3.2 NORTHERN AND SOUTHERN TERMINALS 28
3.2.1 Northern Terminal 29
3.2.2 Southern Terminal 33
3.3 GROUND ELECTRODE SYSTEMS 34
3.4 COMMUNICATIONS SYSTEM 42
3.5 PROPOSED TWE PROJECT CONSTRUCTION PRACTICES 43
3.5.1 Pre-Construction Activities 44
3.5.1.1 Permitting 44
3.5.1.2 ROW and Property Rights Acquisition 44
3.5.1.3 Geotechnical Surveys and Testing 45
3.5.1.4 Pre-Construction Surveys and Flagging 46
3.5.2 Transmission Line Construction 46
3.5.2.1 Access Road Construction 47
3.5.2.2 Clearing of Transmission ROW and Temporary Work Areas 52
3.5.2.3 Excavation and Installation of Foundations and Anchors 56
3.5.2.4 Erection of Transmission Structures 57
3.5.2.5 Stringing of Conductors, Shield Wire, and Fiber Optic Ground Wire 57

3.5.2.6 Clean-up and Site Reclamation ... 59
3.5.3 Terminal and Substation Construction ... 60
3.5.4 Ground Electrode Construction ... 65
3.5.5 Communications System Construction ... 66
3.5.6 Post Construction Clean-Up and Restoration ... 68
3.5.7 Special Construction Practices ... 68
3.5.7.1 Blasting ... 68
3.5.7.2 Helicopter Construction ... 69
3.5.7.3 Roadless Construction Methods ... 71
3.5.7.4 Construction in Sensitive Water Resource Areas ... 72
3.5.8 Water Use ... 74
3.5.9 Construction Schedule, Workforce and Equipment ... 76
3.5.9.1 Construction Schedule ... 76
3.5.9.2 Construction Workforce ... 85
3.5.9.3 Construction Equipment ... 85
3.6 PROPOSED TWE PROJECT OPERATION AND MAINTENANCE PRACTICES ... 92
3.6.1 Transmission Lines ... 92
3.6.2 Transmission Line ROW ... 93
3.6.2.1 Vegetation Management Program ... 93
3.6.2.2 TWE Project Vegetation Management Plan Framework ... 94
3.6.3 Terminals, Substation, Ground Electrodes and Communication Systems ... 107
3.6.3.1 Water Use ... 108
3.6.4 Emergency Response ... 109
3.6.5 Fire Protection ... 110
3.6.6 ROW Safety Requirements ... 111
3.6.7 Building and Fence Grounding ... 111
3.6.8 Decommissioning Practices ... 111
3.7 TWE PROJECT ENVIRONMENTAL MITIGATION MEASURES ... 112

4.0 TWE PROJECT ALTERNATIVES ... 121

4.1 TRANSMISSION LINE ALTERNATIVES ... 121
4.1.1 Transmission Line Design Alternatives ... 121
4.1.2 Transmission Line Construction, Operation and Maintenance Practices ... 121
4.2 PROJECT FACILITY ALTERNATIVES ... 122
4.2.1 Northern Terminal ... 122
4.2.2 Southern Terminal ... 122
4.2.3 Ground Electrode System Alternatives ... 122
4.2.3.1 Northern Ground Electrode Alternative Sites ... 123
4.2.3.2 Southern Ground Electrode Alternative Sites ... 123
4.3 SYSTEM ALTERNATIVES ... 123
4.3.1 Overview of Alternative Systems ... 124
4.3.2 Alternative Systems' Purpose and Need and Design Characteristics ... 127
4.3.2.1 System Alternative 2 – DC from Wyoming to IPP, AC from IPP to Marketplace Hub ... 127
4.3.2.3 System Alternative 3 – Phased Build Out ... 132
4.3.3 Construction, Operation and Maintenance Activities of System Alternatives ... 134
4.3.3.1 System Alternative Construction Activities, Workforce and Equipment Requirements ... 136
4.3.3.2 System Alternative Construction Schedules ... 138
4.3.3.3 Induced Currents on AC Transmission Systems ... 139
4.3.4 Comparison of Proposed TWE Project to System Alternatives ... 147
4.4 UNDERGROUND ALTERNATIVES ... 150
4.4.1 Underground Cable System Technologies ... 150

5.0 REFERENCES 152

APPENDICES

APPENDIX A
TWE PROJECT COMPONENTS DISTURBANCE AND ACCESS ROAD METHODOLOGY

APPENDIX B
SUPPLEMENTAL MAP EXHIBITS B-1 TO B-6

APPENDIX C
SUPPLEMENTAL INFORMATION – TWE PROJECT VEGETATION MANAGEMENT PROGRAM

APPENDIX D
SUPPLEMENTAL INFORMATION - TECHNICAL INFORMATION OF APPLICABILITY OF INDUCED CURRENT RISKS FOR AC AND DC TRANSMISSION LINES

LIST OF TABLES

TABLE 1 TYPICAL ±600 KV DC TRANSMISSION LINE DESIGN CHARACTERISTICS 15
TABLE 2 ±600 KV DC TRANSMISSION LINE DESIGN ALTERNATIVES POTENTIALLY USED IN CHARACTERISTIC SETTINGS 17
TABLE 3 TYPICAL DESIGN CHARACTERISTICS OF TERMINALS 29
TABLE 4 ACCESS ROAD CATEGORIES AND DISTURBANCE ASSUMPTIONS FOR DEIS ANALYSIS 50
TABLE 5 SUMMARY OF TEMPORARY LAND DISTURBANCE FOR WORK AREAS 52
TABLE 6 ESTIMATED PERSONNEL AND EQUIPMENT FOR TRANSMISSION LINE CONSTRUCTION FOR EACH SPREAD 86
TABLE 7 ESTIMATED PERSONNEL AND EQUIPMENT FOR EACH TERMINAL AND GROUND ELECTRODE SYSTEM 89
TABLE 8 NORTHERN AND SOUTHERN TERMINAL ANNUAL ESTIMATED WATER USE 108
TABLE 9 TWE PROJECT COMMITTED ENVIRONMENTAL MITIGATION MEASURES 113
TABLE 10 ESTIMATED PERSONNEL AND EQUIPMENT FOR SYSTEM ALTERNATIVE SUBSTATIONS. 136
TABLE 11 COMPARISON OF PROPOSED TWE PROJECT TO SYSTEM ALTERNATIVES 147

LIST OF MAP EXHIBITS

MAP EXHIBIT 1 PROPOSED TWE PROJECT – PROPOSED CORRIDOR, REGIONAL VICINITY 4
MAP EXHIBIT 2 PROPOSED ROUTE UTILITY CORRIDOR UTILIZATION 7
MAP EXHIBIT 3 CONCEPTUAL NORTHERN TERMINAL AND GRID INTERCONNECTIONS 32
MAP EXHIBIT 4 CONCEPTUAL SOUTHERN TERMINAL AND GRID INTERCONNECTIONS 36
MAP EXHIBIT 5 NORTHERN TERMINAL AND GROUND ELECTRODE SYSTEM – PROPOSED AND ALTERNATIVE SITES AND SITING AREAS 40
MAP EXHIBIT 6 SOUTHERN TERMINAL AND GROUND ELECTRODE SYSTEM – PROPOSED AND ALTERNATIVE SITES AND SITING AREAS 41
MAP EXHIBIT 7 SYSTEM ALTERNATIVE 2: DC FROM WYOMING TO IPP, AC FROM IPP TO MARKETPLACE HUB 125
MAP EXHIBIT 8 SYSTEM ALTERNATIVE 3: PHASED BUILD-OUT 126

MAP EXHIBIT 9 SYSTEM ALTERNATIVE 2 COMPONENTS 130
MAP EXHIBIT 10 SYSTEM ALTERNATIVE 3 COMPONENTS 135

LIST OF FIGURES

FIGURE 1 TYPICAL ±600 KV DC GUYED V-STRING LATTICE STRUCTURE 18
FIGURE 2 TYPICAL ±600 KV DC SELF SUPPORTING LATTICE V-STRING STRUCTURE 19
FIGURE 3 TYPICAL ±600 KV DC TUBULAR STEEL POLE V-STRING STRUCTURE 20
FIGURE 4 TYPICAL ROW CROSS SECTIONS BY STRUCTURE TYPE 21
FIGURE 5 TYPICAL 500 KV AC SINGLE CIRCUIT SELF SUPPORTING LATTICE STRUCTURE 26
FIGURE 6 TYPICAL 230 KV AC SINGLE AND DOUBLE CIRCUIT POLE STRUCTURE 27
FIGURE 7 TYPICAL AC/DC CONVERTER STATION 28
FIGURE 8 TYPICAL SITE PLAN FOR GROUND ELECTRODE SYSTEM 37
FIGURE 9 TYPICAL ABOVE GROUND CONSTRUCTION AT THE GROUND ELECTRODE FACILITY 38
FIGURE 10 TYPICAL POLE STRUCTURE FOR OVERHEAD ELECTRODE LINE 39
FIGURE 11 COMMUNICATIONS REGENERATION SITE 43
FIGURE 12 STRUCTURE FOUNDATION INSTALLATION, TOWER ASSEMBLY, AND ERECTION ACTIVITIES 48
FIGURE 13 CONDUCTOR STRINGING ACTIVITIES 49
FIGURE 14 TYPICAL ACCESS ROAD CROSS-SECTIONS BY TERRAIN TYPE 51
FIGURE 15 PLAN VIEW OF TYPICAL TRANSMISSION ROW AND CONSTRUCTION WORK AREAS 54
FIGURE 16 TYPICAL ROAD DESIGNS FOR LOW WATER AND CULVERT CROSSINGS 75
FIGURE 17 CONSTRUCTION SCHEDULE FOR 20 MILE SECTION OF ±600 KV DC TRANSMISSION LINE 78
FIGURE 18 CONSTRUCTION SCHEDULE FOR ±600 KV DC TRANSMISSION LINE BY SEGMENT 79
FIGURE 19 CONSTRUCTION SCHEDULE FOR NORTHERN AND SOUTHERN TERMINALS 82
FIGURE 20 CONSTRUCTION SCHEDULE FOR GROUND ELECTRODE SYSTEM 84
FIGURE 21 LEVEL 1 STANDARD ROW VEGETATION MANAGEMENT – CROSS SECTION VIEW 97
FIGURE 22 LEVEL 1 STANDARD ROW VEGETATION MANAGEMENT – PROFILE VIEW 98
FIGURE 23 LEVELS 1, 2, AND 3 VEGETATION CLEARANCE ZONE FOR GUYED STEEL LATTICE TOWER 99
FIGURE 24 LEVELS 1, 2, AND 3 VEGETATION CLEARANCE ZONE FOR TUBULAR STEEL POLE AND SELF SUPPORTING STEEL LATTICE TOWER 100
FIGURE 25 LEVELS 2 AND 3 SELECTIVE ROW VEGETATION MANAGEMENT – CROSS SECTION VIEW 101
FIGURE 26 LEVEL 2 SELECTIVE ROW VEGETATION MANAGEMENT – WIRE ZONE PROFILE VIEW 103
FIGURE 27 LEVELS 2 AND 3 SELECTIVE ROW VEGETATION MANAGEMENT – BORDER ZONE PROFILE VIEW 104
FIGURE 28 LEVEL 3 SELECTIVE ROW VEGETATION MANAGEMENT – WIRE ZONE PROFILE VIEW 106
FIGURE 29 TYPICAL 500 KV AC SINGLE CIRCUIT TUBULAR POLE STRUCTURE 129
FIGURE 30 TYPICAL 345 KV AC DOUBLE CIRCUIT SELF SUPPORTING STEEL POLE STRUCTURE ... 131
FIGURE 31 CONSTRUCTION SCHEDULE FOR SYSTEM ALTERNATIVE 2 TERMINALS, SUBSTATIONS AND SERIES COMPENSATION STATION 140
FIGURE 32 CONSTRUCTION SCHEDULE FOR SYSTEM ALTERNATIVE 3 SUBSTATIONS AND SERIES COMPENSATION STATION 142
FIGURE 33 CONSTRUCTION SCHEDULE FOR SYSTEM ALTERNATIVE 3 TRANSMISSION LINE 144

ACRONYMS AND ABBREVIATIONS

AASHTO	American Association of State Highway and Transportation Officials
AC	alternating current
AC/DC	alternating current/direct current
ACSR	aluminum conductor steel reinforced
ANSI	American National Standards Institute
APLIC	Avian Power Line Interaction Committee
APS	Arizona Public Service
ATV	all terrain vehicles
BLM	Bureau of Land Management
BMP	Best Management Practices
COM Plan	Construction, Operation and Maintenance Plan
CWA	Clean Water Act
DC	direct current
DEIS	Draft Environmental Impact Statement
DOE	U.S. Department of Energy
DOT	Department of Transportation
EHV	extra high voltage
EIS	Environmental Impact Statement
EMF	Electromagnetic Field
E.O.	Executive Order
EPA	Environmental Protection Agency
ESA	Endangered Species Act
FAA	Federal Aviation Administration
FEIS	Final Environmental Impact Statement
FERC	Federal Energy Regulatory Commission
FLPMA	Federal Land Policy and Management Act of 1976
FPEIS	Final Programmatic Environmental Impact Statement
GIS	Geographic Information System
HV	high voltage
HVDC	high voltage direct current
IPP	Intermountain Power Plant
IRA	Inventoried Roadless Areas
IVM	integrative vegetation management
kV	kilovolt
LADWP	Los Angeles Department of Water and Power
LP	liquid propane
LPP	laminated polypropylene paper
MI	Mass impregnated
MVCD	Minimum Vegetation Clearance Distance
MW	megawatt
NAGPRA	Native American Graves Protection and Repatriation Act
NEPA	National Environmental Policy Act of 1969
NERC	North American Electric Reliability Corporation
NESC	National Electrical Safety Code
NHPA	National Historic Preservation Act
NOI	Notice of Intent

NPDES	National Pollutant Discharge Elimination System
NRCS	National Resource Conservation Service
NTTG	Northern Tier Transmission Group
OPGW	optical ground wire
PA	Programmatic Agreement
PDTR	Project Description Technical Report
POD	Plan of Development
POWER	POWER Engineers, Inc.
ROD	Record of Decision
ROW	Right-of-Way
RPPR	Regional Planning Project Review
SCADA	Supervisory Control and Data Acquisition
SCFF	Self-contained fluid filled
SHPO	State Historic Preservation Office
STS	Southern Transmission System
TransWest	TransWest Express LLC
TWE Project	TransWest Express Transmission Project
UHF	ultra high frequency
USACE	U.S. Army Corps of Engineers
USDI	United States Department of Interior
USFS	United States Forest Service
VHF	very high frequency
VRM	Visual Resource Management
WECC	Western Electricity Coordinating Council
Western	Western Area Power Administration
WIA	Wyoming Infrastructure Authority
WWEC	West-wide Energy Corridor
XLPE	Cross linked polyethylene

1.0 INTRODUCTION

1.1 PDTR Purpose and Scope

TransWest Express LLC (TransWest/Applicant) has prepared this Project Description Technical Report (PDTR) in support of the Draft Environmental Impact Statement (DEIS) for the TransWest Express Transmission Project (TWE Project). The DEIS is being prepared by the U.S. Department of the Interior (USDI), Bureau of Land Management (BLM), the U.S. Department of Energy (DOE), and Western Area Power Administration (Western), in compliance with the requirements and guidelines of the National Environmental Policy Act of 1969 and the Federal Land Policy and Management Act of 1976 (FLPMA). The PDTR provides a description of the TWE Project for the lead agencies' use in preparing Chapter 2 (Project Description and Alternatives) of the DEIS. The PDTR addresses the proposed TWE Project and alternatives presented by the lead agencies during public scoping. The PDTR also contains detailed design, construction, operation and maintenance information for the agencies' use in the analyses of environmental impacts and mitigation measures adopted by the Applicant for the proposed TWE Project and DEIS alternatives.[1]

The PDTR is presented in the following major sections:

Section 2.0 TransWest Proposed Action, including: a summary of the TWE Project components; purpose and need; technical reliability and commercial requirements; and the TWE Project history, including early planning studies and alternatives considered by the Applicant in determining the proposed TWE Project.

Section 3.0 Project Description, including: the typical design characteristics of the proposed transmission system, terminal stations, ground electrode systems and communication systems; the construction, operation, and maintenance practices; and environmental protection measures adopted by TransWest as part of the TWE Project.

Section 4.0 Alternatives including alternative locations for the terminals and ground electrodes; two system alternatives; and undergrounding.

The appendices provide pertinent background information to the PDTR. Appendix A contains information regarding the methodology used for estimating temporary and permanent disturbances resulting from the TWE Project components and access roads. Appendix B contains maps related to early planning studies and environmental constraint analyses. Appendix C provides supplemental information requested by the lead agencies regarding the TWE Project Vegetation Management Program; and Appendix D provides technical information regarding the potential for induced currents on alternating current (AC) and direct current (DC) transmission lines (AECOM 2010).

1.2 Definitions of Key Terms

Key terms used throughout the PDTR are defined below.

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[1] The PDTR does not address the full range of alternatives, which the lead agencies will determine for the DEIS. The PDTR provides information pertinent to the proposed TWE Project and National Environmental Policy Act (NEPA) scoping alternatives.

Transmission Line Corridors – Corridors are defined as geographic areas generally varying in width between two and six miles within which the proposed 250 foot-wide TWE Project transmission line right-of-way (ROW) would be located. Corridor widths have varied among the various studies completed for TWE Project planning. For purposes of the DEIS analysis, the Proposed and Alternative Corridors have been refined to generally two miles wide. In limited areas, the corridor widths may be greater or lesser due to routing constraints, as requested by the joint lead agencies. These corridors will be evaluated in the DEIS to document the range of resource impacts which could result from transmission line construction, operation, and maintenance within the corridors. Corridor locations and widths have been, and will continue to be, refined throughout the National Environmental Policy Act (NEPA) process.

Transmission Reference Lines – Reference lines are preliminary, non-engineered routes within corridors that were determined based on environmental and engineering constraints and constructability review. The reference line is generally bounded on each side by one mile of corridor. For purposes of the DEIS analysis, reference lines serve as preliminary centerlines for the location of the ±600 kV DC transmission line ROW. Reference line locations will be refined within the transmission line corridors throughout the NEPA process.

Route Segments – Reference lines defined above are divided into route segments, which are identified by a nomenclature of letters and numbers. The route segments will be used to identify alternative end-to-end routes for the transmission line and to quantify and compare potential impacts resulting from these alternative routes.

Alternative Routes – Alternative routes for the TWE Project are defined as a series of corridor segments, which, when combined, define a potential corridor and reference line location for the TWE Project between common geographic points. For the TWE Project DEIS analysis, the lead agencies are identifying and comparing alternative routes according to four distinct regions: Region I - Sinclair, Wyoming, to Northwest Colorado near Rangely, Colorado; Region II - Northwest Colorado to IPP near Delta, Utah; Region III – IPP to North Las Vegas, Nevada; and Region IV - North Las Vegas to Marketplace Hub near Boulder City, Nevada.

TWE Project Alignment – The TWE Project alignment is defined as an engineered route, which will be prepared for the Agency Preferred Alternative. The Project Alignment will be based on engineering and design of the transmission line including specific structure locations. The Agency Preferred Alternative will be determined by the lead agencies, following the public review period on the DEIS, and in consultation with federal, state, and local cooperating agencies.

System Alternatives – System alternatives are alternative transmission configurations, which may have the potential to meet the TWE Project purpose and need, depending on future energy market conditions and permitting decisions for other regional transmission systems. Two system alternatives are described in the PDTR.

2.0 TRANSWEST PROPOSED ACTION

2.1 TWE Project Components

The proposed TWE Project consists of the following components:

- A ±600 kV DC transmission line between south-central Wyoming and southern Nevada. A 250 foot wide ROW will generally be required for the ±600 kV DC transmission line.

- Two terminals for the alternating current/direct current (AC/DC) converter stations and related substations, to be located at either end of the ±600 kV DC transmission line. The proposed TWE Project includes a Northern Terminal near Sinclair, Wyoming, and a Southern Terminal south of Boulder City, Nevada near the Marketplace Hub in the Eldorado Valley, with interconnections to the existing and planned regional AC transmission grid.

- Two independent communications systems, including a dedicated fiber optic network, for command and control of the transmission system. The fiber optic network will require regeneration sites at periodic distances along the ±600 kV DC transmission line. In most cases the regeneration sites will be located within the transmission line ROW. The second communication system will use existing private networks. Microwave antennas may be located at the terminals to connect into these private systems.

- Two ground electrode systems, to be located within approximately 100 miles of the terminals. A low voltage overhead line will be needed to connect the ground electrode systems and AC/DC converter stations.

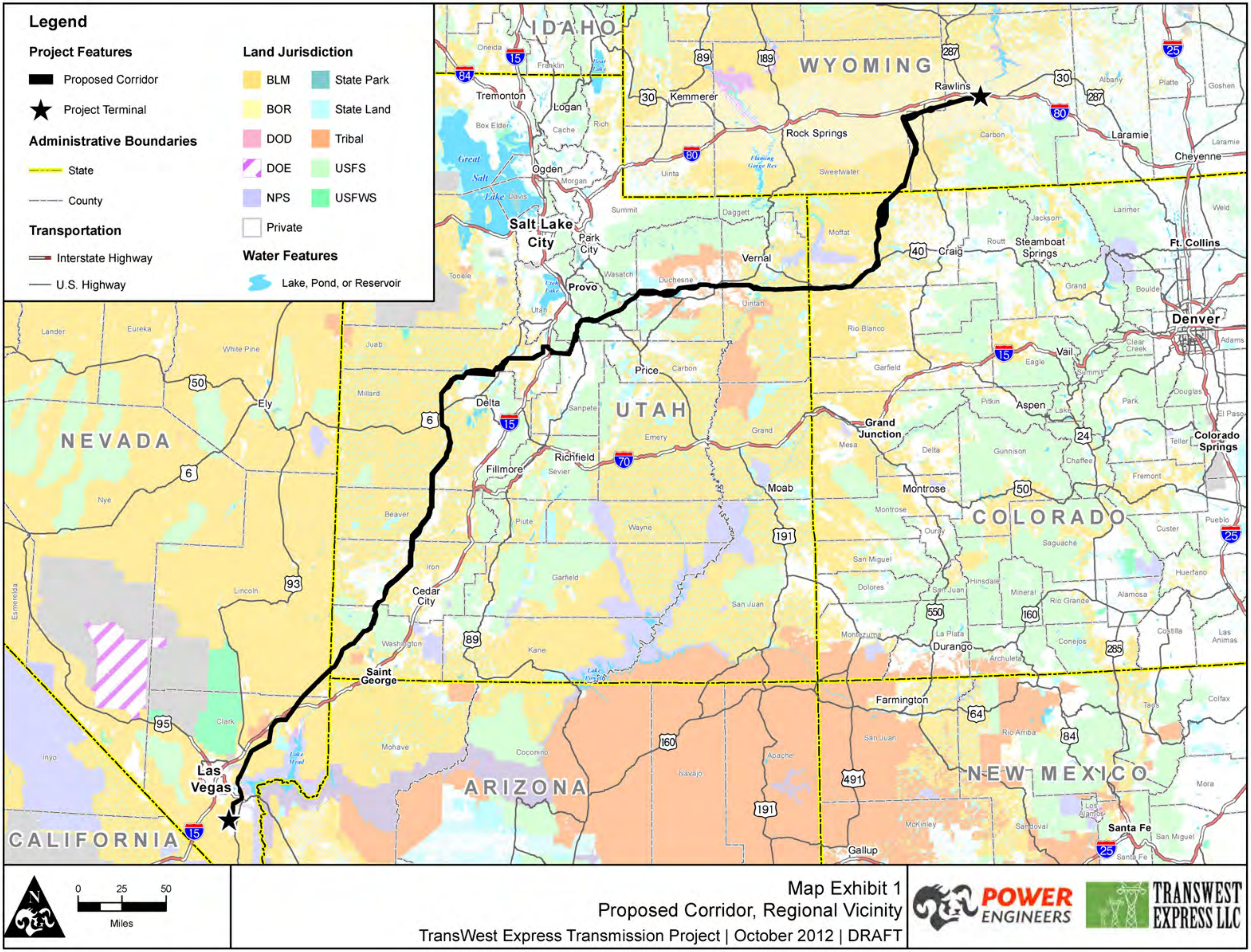
- Access roads to the TWE Project facilities. The TWE Project's proposed Access Road Plan entails making improvements to existing roads, constructing new roads and using overland access methods for the construction, operation, and maintenance of the TWE Project. Existing roads will be used to the extent feasible. Roadless construction methods are proposed in limited areas where the transmission line would cross Inventoried Roadless Areas (IRAs).

- Temporary work areas will be required during construction of the TWE Project including terminals; ground electrode systems; structures; staging areas; material storage areas; fly yards; pulling, tensioning, and splicing sites; communication and regeneration sites; and batch plants.

2.2 TWE Project Location

2.2.1 Regional Vicinity

The proposed TWE Project crosses portions of Wyoming, Colorado, Utah and Nevada. Map Exhibit 1 shows the regional setting of the proposed TWE Project with respect to state and counties crossed.



Map Exhibit 1
Proposed Corridor, Regional Vicinity
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2.2.2 Designated Utility Corridors

The TWE Project transmission line will be approximately 725 miles long, and will follow designated utility corridors for approximately 78 percent of the entire length of the line. Map Exhibit 2 shows the location of the proposed TWE Project corridor and identifies where the transmission line follows utility corridors. Designated corridors, identified on Map Exhibit 2, include corridors designated: (1) by the Department of Energy in November 2008 as West-wide Energy Corridors (WWEC) pursuant to Section 368 of the Energy Policy Act; (2) by the Bureau of Land Management (BLM) and the United States Forest Service (USFS) in their respective land management plans (various dates); (3) by state and county land use plans (i.e., Millard County, Utah major utilities corridor); (4) by connection to federally designated corridors on private and state lands because of their proximity to the federal lands with these designations; and (5) by locating the line adjacent to existing utility line corridors.

2.3 TWE Project Technical Requirements

2.3.1 NERC Standards and WECC Regional Criteria Guidelines

The Reliability Standards used within the electric utility industry for the bulk power electrical grid are developed by the North American Electric Reliability Corporation (NERC). The Western Electricity Coordinating Council (WECC) develops Regional Criteria that supplement the NERC Standards. The West-Wide Energy Corridor (WWEC) Final Programmatic Environmental Impact Statement (FPEIS) includes a comprehensive overview of this subject in Chapter 2, Section 2.6.3, *What Steps Are Being Taken To Ensure The Reliability of Bulk Electricity Transmission* (DOE et al. 2008). The overview includes a description of how NERC and WECC regulate the industry through a wide series of standards that address all facets of the bulk electricity transmission grid, including design, planning, operations, infrastructure and cyber security, communication, coordination and operational safety.

These reliability standards affect the technical aspects of the TWE Project in several ways. Reliability standards limit the operational capacity of any single transmission system element based on a complex contingency analysis that considers the impact to grid operations following various events (e.g. equipment failures, line outages).

Reliability standards affect the TWE Project ROW requirements and separation requirements from other high voltage lines. As a single transmission system element, the TWE Project is effectively limited in capacity to approximately 3,000 megawatts (MW).

The contingency analysis required for new transmission projects such as the TWE Project involves examining several types of events including the loss of "Adjacent Transmission Circuits" and the loss of multiple transmission lines within a corridor.

WECCs Regional Criteria addresses separation distances based upon the location of a project from Adjacent Transmission Circuits. WECC requires a minimum separation distance between high voltage transmission lines. The WECC Regional Criteria specifies that to avoid being rated as Adjacent Transmission Circuits, or common transmission system elements, circuits must be separated by "at least 250 feet between the transmission circuits" (WECC 2012). The applicability of this portion of the Regional Criteria is for circuits greater than or equal to 300 kV. The loss of multiple lines within a corridor involves analyzing impacts after a line outage of the TWE Project transmission line and any other transmission line(s) within the corridor. The most likely event would be the loss of the TWE Project and an adjacent transmission line.

The likelihood of having a line outage of two transmission lines is even higher at places where transmission lines cross one another. The mechanical failure of the top line would typically cause the line below to also fail. The practicality of needing transmission lines to cross is recognized in the standards; however, the number of crossings needs to be minimized to reduce the likelihood of such an event. This same concept of the practical need for line crossings and the treatment of these within the siting criteria have been extended to develop a TWE Project Transmission Line Co-location Framework. The framework allows for the use of various separation distances depending on localized siting constraints and the voltages of other transmission lines within the corridor.

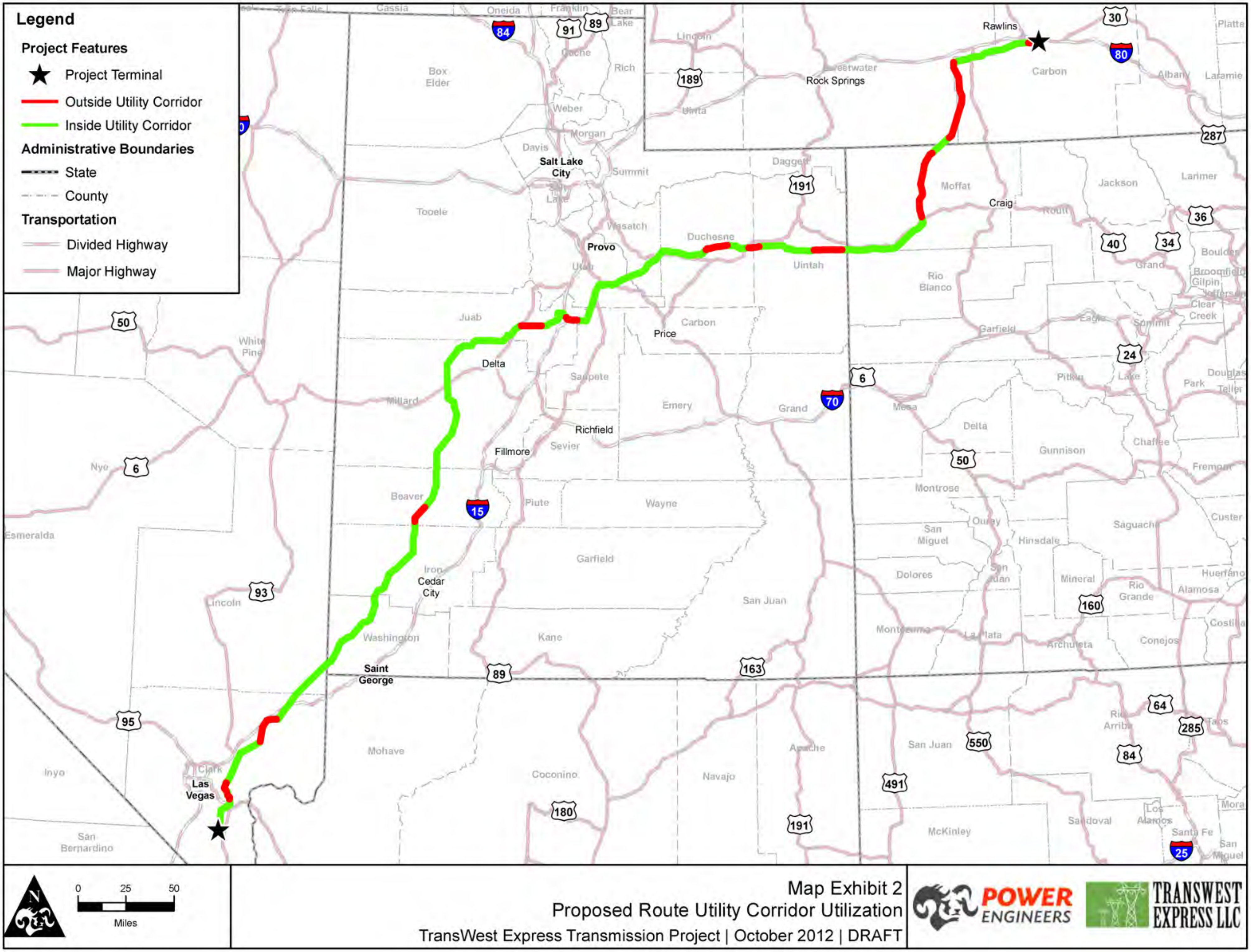
Reliability analysis examining the scenario where multiple lines are lost including the TWE Project has shown this loss will have a significant impact on transmission grid performance, including local and widespread transmission grid blackouts. This reliability analysis has found that the higher the capacity of the line lost along with the TWE Project, the more severe the transmission grid performance consequences. The reliability analysis also demonstrated that it is not feasible for the TWE Project and another transmission project to use common structures for any portion of the route.

The TWE Project Co-location framework outlined below provides for: (1) the application of TransWest's desired separation criteria; and (2) the selective use of a less stringent separation criteria depending on the circumstances. The framework utilizes two different separation distances, either a tower span distance of 1,500 feet or a tower height distance of 250 feet; separation distances in the framework are applied based on different variables including the TWE Project design, the voltage of the Adjacent Transmission Circuit(s), and the localized siting conditions and constraints. The 250 foot separation distance represents the absolute minimum separation distance for the TWE Project and other transmission lines of any voltage. The framework set out below addresses co-location requirements and implementation measures for three levels or situations: (1) standard co-location distances; (2) selective situational co-location distances; and (3) extreme situational co-location distances.

2.3.1.1 Level 1 – Standard Co-Location Distances

Level 1 represents the TWE Project separation criteria to be applied to the majority of situations involving Adjacent Transmission Circuits and is TransWest's preferred standard. Meeting Level 1 separation criteria is the most effective and prudent way to meet and exceed the Reliability Standards and WECC Regional Criteria. Level 1 will allow TransWest to meet its objectives for the TWE Project of providing 3,000 MW of transmission capacity while improving electrical grid reliability, and utilizing existing and designated utility corridors. Level 1 entails:

- Maintaining a separation distance of at least 1,500 feet between the TWE Project and transmission lines with a voltage rating of 345 kV and above, and
- Maintaining a minimum separation distance of at least 250 feet between the TWE Project and transmission lines with a voltage rating below 345 kV.



Map Exhibit 2

Proposed Route Utility Corridor Utilization

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2.3.1.2 Level 2 – Selective Situations Co-location Distances

Level 2 represents separation criteria that will be acceptable for limited portions of the TWE Project transmission line route depending on the situation. Level 2 can be utilized where impacts to highly sensitive resources or land use areas identified through the environmental analysis process can be effectively mitigated by using Level 2 co-location distances. Level 2 co-location distances would meet the Reliability Standards, but is less desirable than Level 1 given the increased impact on reliability. Consequently Level 2 would be applied selectively to only those portions of the route where the TWE Project would be co-located near 345 kV transmission lines and where the implementation of Level 2 would effectively mitigate potential impacts to highly sensitive resources or land use areas. Level 2 entails:

- Maintaining a separation distance of at least 1,500 feet between the TWE Project and transmission lines with a voltage rating above 345 kV, and
- Within selective areas of highly sensitive resources or land uses, maintaining a separation distance of at least 250 feet between the TWE Project and transmission lines with a voltage rating of 345 kV, and
- Maintaining a minimum separation distance of at least 250 feet between the TWE Project and transmission lines with a voltage rating below 345 kV.

2.3.1.3 Level 3 – Extreme Situations Co-location Distances

Level 3 represents separation criteria to be utilized only for very limited portions of the TWE Project transmission line route and only in extreme situations. For instance, Level 3 Extreme Situations Co-location Distances can be used where there are extreme physical or other siting constraints or where the environmental analysis identifies impacts that can be effectively mitigated with Level 3 co-location distances. Level 3 Extreme Co-location Distances would meet the Reliability Standards, but only if they are applied to the shortest possible distance and for a very limited number of times. System analysis has shown that outage of the TWE Project along with other 500 kV transmission lines would result in extreme consequences for the transmission grid in the form of widespread blackouts. The Level 1 Standard Co-location Distances for the TWE Project and other 500 kV lines reduces the likelihood of a failure of the transmission grid resulting in blackouts as compared to utilizing the 250 foot distance. The Reliability Standards require an examination of the possibility of single and multiple line failures and their potential impact on transmission grid performance. The Reliability Standards also require the development of additions to the grid, such as the TWE Project, to be designed in such a way to decrease the likelihood of these events occurring over the life of the project. The Level 1 Standard Co-location Distances meet this requirement for the TWE Project. Any deviation from the Standard Co-location Distances for the TWE Project and other 500 kV lines increases the likelihood of transmission grid blackouts from the loss of multiple lines. Therefore, the number and extent of these deviations need to be minimized to meet the Reliability Standards. Consequently, Level 3 Extreme Situations Co-location Distances would be applied very selectively for short distances where its implementation would effectively mitigate potential impacts to extreme physical or other siting constraints. Level 3 entails:

- Reducing the separation distance within areas of extreme physical or other siting constraints for as short a distance as practical and for only a limited number of occurrences to no less than 250 feet between the TWE Project and transmission lines with a voltage rating above 345 kV; and

- Within selective areas of highly sensitive resources or land uses, maintaining a separation distance of at least 250 feet between the TWE Project and transmission lines with a voltage rating of 345 kV, and
- Maintaining a minimum separation distance of at least 250 feet between the TWE Project and transmission lines with a voltage rating below 345 kV.

The Transmission Line Co-location Distances Framework for the TWE Project has been established based on preliminary reliability analysis in accordance with industry reliability standards. This analysis is ongoing and is subject to the review of WECC members. Therefore, if underlying assumptions used in the preliminary analysis are found to be inaccurate or if those assumptions change, then the minimum siting criteria for the TWE Project may need to be revised further.

2.3.2 Commercial Requirements

In addition to the NERC and WECC standards and guidelines, TransWest has identified a commercial need for the TWE Project to include the potential for a future interconnection with the IPP system. Planning for a possible interconnection will provide future flexibility for transmitting available renewable energy resources through the existing transmission grid if and when transmission capacity becomes available (TWE 2010b).

2.4 TWE Project History

The history of alternatives considered in early planning studies, and documented in the ROW Application SF 299 and POD submittals to BLM, is described below. Map Exhibits referenced in this PDTR section are located in Appendix B.

2.4.1 Alternatives Considered Early On (Pre-BLM Application Filings)

2.4.1.1 2006-2008 Electrical Transmission System Planning Studies

Electrical transmission system planning studies were initially undertaken in September 2006 to assist in identifying a range of alternatives for the TWE Project and other regional-scale transmission projects planned to facilitate the transmission of power to markets in the Desert Southwest region.

Pertinent early planning studies included:

- In 2007, the TWE Project was the subject of a Regional Planning Project Review (RPPR), conducted in accordance with WECC Planning Procedures. The purpose of the planning process was to review projects on a regional basis, using an open and transparent process to identify, and potentially reconfigure or combine, the proposed projects under review. This review was conducted jointly with the Energy Gateway South 500 kV Project, sponsored by PacifiCorp, doing business as Rocky Mountain Power, which was originally planned to start in Wyoming and terminate in southern Nevada. As a result of this review, the TWE Project was reconfigured to have the Northern Terminal moved from northeast Wyoming to south central Wyoming and the Southern Terminal moved from central Arizona to southern Nevada. The findings of the RPPR Conceptual Technical Report concluded that the TWE Project's proposed ±600 kV DC transmission system, coupled with Energy Gateway South's 500 kV AC Project, would serve the needs of the broader region of Utah, Arizona, Nevada and Southern California most cost effectively, while minimizing potential environmental impacts (TWE 2008a).

- The TWE Project was included in the study work performed as part of the Northern Tier Transmission Group (NTTG) 2007 Annual Planning Report (NTTG 2007). The NTTG is a sub-regional transmission group that, among other responsibilities, coordinates regional planning efforts in the Northwest and Mountain states.

- The TWE Project was included in the WestConnect 2008-2017 Transmission Plan. WestConnect is another sub-regional transmission group that coordinates regional planning efforts in Nevada, Arizona, New Mexico, and Colorado (WestConnect 2005).

2.4.1.2 2006-2008 Regional Corridor Studies

Initial regional corridor studies were conducted in 2006 (APS 2006). The study area extended from Wyoming to Arizona, including corridors in the states of Idaho, Utah, Colorado, Nevada, and New Mexico. Regional environmental studies were conducted during the same time period, using available secondary data. A series of preliminary corridors up to four miles wide, which had been identified as desirable by electrical system planners, were evaluated. Results of these studies indicated the general environmental feasibility of system planning alternatives.

A second regional corridor study was initiated in September 2007 to identify preliminary alternative transmission corridors for both the TWE Project and Energy Gateway South 500 kV Project. This study was completed in February 2008 (APS, et al. 2008) to document environmental constraints and opportunities within the region and to identify and refine potential alternative corridors that would meet the electrical system planning requirements of the TWE Project. During this study, a more detailed review of environmental data and federal land management plans was completed, as well as communication and consultation with federal agencies.

2.4.2 Transmission Corridors and Facility Sites Identified in BLM Application Filings

The TWE Project Preliminary ROW Application SF 299 submitted in 2007 initiated the BLM's review of the Project and NEPA compliance process. This section of the PDTR provides a chronology of the BLM filings for the TWE Project and documents the alternative corridors considered in those submittals (NGTSC 2007, TWE 2008b, TWE 2009, TWE 2010b and TWE 2010c). Map Exhibits B-1 to B-6 in Appendix B show the results of these early planning studies in relationship to the proposed and alternative corridors and reference lines.

- *TransWest Express Transmission Project, Preliminary ROW Application SF 299, November 2007 – prepared by National Grid.*

The Preliminary ROW Application SF 299 and preliminary POD submitted in November 2007 identified a broad array of potential alternative corridors, extending between east-central Wyoming and central Arizona. These alternatives had been identified through the APS 2006 corridor studies. The proposed corridor extended approximately 1,300 miles. Map Exhibit B-1 shows the proposed and alternative corridors associated with the November 2007 application. At that point in the planning process, both AC and DC transmission systems were under study; and alternative corridors were typically four miles wide.

- *TransWest Express Transmission Project, Preliminary ROW Application SF 299, December 2008 and Preliminary POD, January 2009 (Amended from November 2007) – prepared by TransWest Express LLC.*

TransWest acquired the TWE Project in 2008 and filed an amended Preliminary ROW Application SF 299 with the BLM Wyoming State Office for a ±600 kV DC transmission line in December 2008. The amended preliminary POD was subsequently submitted in January 2009. The Project area was amended to extend between renewable energy sources in south-central Wyoming and southern Nevada, where Project power could connect to transmission systems for load centers in the southwest. A proposed corridor and seven corridor alternatives were addressed in the amended Preliminary ROW Application SF 299. The proposed TWE Project corridor was routed to follow designated energy corridors to the greatest extent possible, including those designated by the DOE in November 2008 as WWEC, pursuant to Section 368 of the Energy Policy Act of 2005; and corridors identified by the BLM and the USFS in their respective land management plans (various dates).

Alternatives shown in the December 2008 Preliminary ROW Application SF 299 incorporated pre-scoping alternatives that were under review by the BLM at the time. Preliminary reference lines for corridors were defined based on available information on environmental constraints (APS 2006), designated energy corridors, existing utilities and transportation systems, and land ownership. Map Exhibits B-2 and B-3 show the proposed and alternative reference lines and six mile-wide corridors from the December 2008 Preliminary ROW Application SF 299.

- *TransWest Express Transmission Project, Preliminary ROW Application SF 299 (Amended from December 2008) January 2010 - prepared by TransWest Express LLC.*

In January 2010, TransWest submitted an amended Preliminary ROW Application SF 299 to provide additional information and clarifications regarding the TWE Project purpose and need, and proposed Project facilities. The amended Preliminary ROW Application SF 299 identified the need to provide for a potential interconnection with IPP near Delta, Utah. Based on TransWest's review of the BLM's October 2009 alternative route segments, which were under review by BLM as part of the pre-scoping process with federal, state, and local cooperating agencies, TransWest recommended that certain route segments be eliminated from further consideration because they would not facilitate an interconnection with IPP. These eliminated segments included: U125, U190, U195, U225, U230, U235, U240, and U245. Concurrently, TransWest recommended that several route segments, which BLM had eliminated early on from consideration, be reconsidered, specifically segments U781, U784, and U785 (TWE 2010d). In June 2010, TransWest further recommended that alternative routes N35A, N40A, and N90A also be eliminated, based on routing congestion in Nevada (TWE 2010e). Map Exhibits B-4 and B-5 show the proposed and alternative routes from the January 2010 amended Preliminary ROW Application SF 299, which includes some of these route segment eliminations.

- *TransWest Express Transmission Project, Preliminary POD (Amended from January 2009) July 2010 - prepared by TransWest Express, LLC.*

The proposed and alternative TWE Project corridors and preliminary reference lines were subsequently refined in 2010. At the request of BLM, TransWest provided recommendations to BLM and Western on the refinement of corridors and revisions to reference lines (POWER 2010).

Corridors were generally recommended to be reduced in width from six miles to two miles based on pre-scoping agency input and known environmental constraints. The reference lines were refined, based on the most current available information on environmental constraints and engineering criteria. Updated information included, but was not limited to, proposed wilderness areas identified in the Colorado Wilderness Act of 2009, updated sage-grouse lek data for Wyoming, and more precise data on the locations of existing utilities. Recommendations on the narrowed corridors and revised preliminary reference lines were submitted to BLM as part of the amended preliminary POD in July 2010. The amended POD also provided additional information on TransWest's ancillary facilities, NERC standards, WECC criteria for transmission reliability and line separation, and TransWest's committed mitigation measures. Map Exhibit B-6 illustrates the July 2010 refined corridors.

- *TWE Project Corridor Reference Line Refinements - March 2011*

In March 2011, further refinements to the TWE Project proposed and alternative corridor reference lines were submitted to BLM (TWE 2010f). Refinements were made to the corridor reference lines, where necessary, to ensure the DEIS alternatives would meet TransWest's updated line separation criteria (TWE 2010a, 2010f). All reference line adjustments were made within the boundaries of the corridors presented by BLM and Western during public scoping.

- *TransWest Express Transmission Project, Preliminary ROW Application SF 299 (Amended from January 2010) – August 2011 - prepared by TransWest Express LLC.*

In August 2011, TransWest submitted a letter that amended the Preliminary ROW Application SF 299 to incorporate corridors supported by certain counties in Wyoming, Colorado and Utah. By Joint Resolution Regarding Preferred Power Line Corridors between the Boards of County Commissioners of Moffat County, Colorado; Carbon County, Wyoming; and Sweetwater County, Wyoming adopted in July 2011, the counties expressed their preference that the TWE Project transmission line follow the Old Dad Road corridor in Wyoming, and the Seven Mile Ridge corridor in Colorado. TransWest supported siting of the transmission line in both of these corridors and revised its Proposed Action to incorporate the Old Dad Road corridor in Carbon and Sweetwater Counties and the Seven Mile Ridge corridor in Moffat County as TransWest's proposed route. By Joint Resolution Regarding Preferred Power Line Corridors between the Boards of County Commissioners of Millard, Utah, and Juab counties, Utah adopted in August 2011, the counties expressed their preference that the TWE Project transmission line follows the UNEV route in Juab County and the West Wide Corridor in Millard County. TransWest supported siting of the transmission line in these corridors and revised its Proposed Action to incorporate the UNEV route in Juab County and the West Wide Corridor in Millard County.

- *TransWest Express Transmission Project, Preliminary ROW Application SF 299 (Amended from August 2011) – August 2012 - prepared by TransWest Express LLC.*

In August 2012, TransWest submitted a letter that amended the Preliminary ROW Application SF 299 to eliminate System Alternative 1 from further consideration. As stated in the ROW Application, System Alternative 1 would be required if interconnections with PacifiCorp's planned 500 kV system, which consists of the Energy Gateway West and Energy Gateway South Projects could not be made near the TWE Project Northern Terminal. TransWest has requested interconnections with PacifiCorp's existing 230 kV system and planned 500 kV system in Wyoming. To best utilize existing and planned transmission infrastructure and to minimize environmental impacts associated with building additional infrastructure, TransWest is seeking the shortest possible interconnection distance between the TWE Project and PacifiCorp's system. Therefore, the need for System Alternative 1 has been dependent on the design, construction and routing of the Energy Gateway

Projects in south-central Wyoming. TransWest understands that all routing alternatives under consideration for the Energy Gateway Projects are located within the Interstate 80 (I-80) corridor between Fort Steel and Rawlins, Wyoming. Placing the Energy Gateway Projects in the I-80 corridor facilitates interconnection with the TWE Project Northern Terminal and eliminates the need for System Alternative 1. In addition, locating the Energy Gateway Projects within the I-80 corridor complies with BLM's policy to avoid proliferation of ROW and has the least cumulative impacts.

- *TransWest Express Transmission Project, Preliminary ROW Application SF 299 (Amended from August 2012) – October 2012 - prepared by TransWest Express LLC.*

TransWest submitted a letter that amended the Preliminary ROW Application SF 299 to modify the Southern Terminal siting area to exclude certain lands with a conservation easement and other lands for which there may be development conflicts and to include a feasible location for the TWE Project Southern Terminal on lands administered by the BLM within the Eldorado Valley near Boulder City, Nevada. The ROW application describes the Southern Terminal as being located on private land. After review of the siting constraints and opportunities for the Southern Terminal, TransWest has modified the terminal siting area to exclude the Multi-Species Habitat Conservation Easement and to include a portion of BLM land immediately east of the existing transmission line corridor running directly north of the existing 500 kV substations. This area has been added due to reduction of the area within the conservation easement and the congestion caused by the existing and potential transmission facilities that may be sited within the area. The BLM administered portion of the Southern Terminal siting area provides a site that is in alignment with the Applicant Proposed Route, will avoid the need for additional line crossings and has adequate terrain. Map Exhibit 4 shows the modified terminal siting area and the potential location of the terminal site on BLM land.

2.4.3 System Alternatives Identified by Applicant

A range of system configurations has been evaluated for the TWE Project. TransWest identified three system alternatives in the *TransWest Express Transmission Project ROW Application SF 299 (Amended from December 2008) January 2010*, which may have the potential to meet the TWE Project purpose and need (TWE 2010b). In August 2012, TransWest submitted an amendment to this application eliminating System Alternative 1 from further consideration in the EIS (TWE 2012). Consideration of the remaining System Alternatives 2 and 3 in the NEPA process would provide the TWE Project flexibility to adapt to potential regional transmission system changes, which could occur in the next two to three years. The feasibility of these system alternatives depends on future permitting decisions for other regional systems and/or future energy and transmission market conditions. System alternatives are described in PDTR Section 4.3.

3.0 PROJECT DESCRIPTION

Sections 3.1 through 3.4 describe the typical design characteristics for the proposed TWE Project facilities:

- Section 3.1 – the TWE Project ±600 kV DC Transmission Line, including structure designs and foundations, conductors, insulators and associated hardware, overhead shield (ground) wires, grounding rods, and minor hardware; and grid interconnection lines.
- Section 3.2 – the TWE Project Northern and Southern Terminals, including the AC/DC converter stations, and substation equipment.
- Section 3.3 – the TWE Project ground electrode systems, including the ground electrode facilities and low voltage electrode connector line(s).
- Section 3.4 – the TWE Project communications system for command and control of the transmission system.

Sections 3.5 describes the construction practices that would be performed for the TWE Project, including standard construction activities, schedules and equipment/manpower requirements, and special construction practices which will be used in selective or sensitive environments.

Section 3.6 discusses operation and maintenance practices for the TWE Project, including routine maintenance and vegetation management of the transmission line ROWs, emergency response, fire protection, and ROW safety requirements.

Section 3.7 summarizes the TWE Project mitigation measures, which are part of the proposed TWE Project Description, and would be common to all the DEIS Alternatives.

3.1 TWE Project ±600 kV DC Transmission Line

The TWE Project proposed ±600 kV DC transmission line will be approximately 725 miles long, located in a ROW 250 feet wide. The design characteristics of the ±600 kV DC transmission line are summarized in Table 1 and are described in this section.[2]

TransWest has determined that a ROW width of 250 feet is sufficient for the long-term maintenance and operation of the transmission line and will accommodate any of the transmission structure designs under consideration. Increased ROW width may be required in a small number of site specific locations to accommodate rough terrain or unusually long spans. These exceptions will be identified and addressed on a case-by-case basis during final design and engineering of the transmission line. ROW width for the TWE Project is based upon engineering studies that considered:

- Structure configuration (horizontal vs. vertical configurations), pole spacing, and insulator configuration (I-string vs. V-string insulator configurations)

[2] Short segments of 500 kV AC and 230 kV AC transmission lines will be required near the Northern and Southern Terminals to connect to the existing and planned regional transmission grid. The design characteristics of these transmission structures are described in Section 3.1.8.

- Operating voltage, elevation and clearance criteria (National Electrical Safety Code (NESC) and project-specific)
- Conductor size, weight, number and configuration of conductors in the bundle, tensions, and sag
- Span length between structures and conductor blowout (conductor movement envelope under pre-defined wind conditions)
- Structure footprint (guyed vs. self-supported), terrain and maintenance access (space requirements for maintenance equipment at each structure site)
- Audible noise levels at the edge of the ROW
- Potential co-location with buried underground high pressure natural gas and other petroleum pipelines within the same corridor. The DC transmission line can be located in its ROW adjacent to the ROW for such pipelines.

TABLE 1 TYPICAL ±600 KV DC TRANSMISSION LINE DESIGN CHARACTERISTICS

FEATURE	DESCRIPTION
Physical Properties	
Line Length	Would vary by routing alternative.
Structure Design	Proposed Structure Design: guyed steel lattice; Alternative Structure Designs: self supporting steel lattice, tubular steel poles
Structure Height	Guyed steel lattice -120 to 180 feet; self supporting steel lattice -120 to 180 feet; tubular steel poles - 100 to 150 feet
Span Length	Guyed lattice - 900 to 1,500 feet; self supporting steel lattice - 900 to 1,500 feet; tubular steel poles - 700 to 1,200 feet
Number of Structures per Mile	Four to eight - depending on structure type, terrain, and other factors to be identified through detailed design studies
ROW Width	250 feet; Increased ROW may be required in a small number of site specific locations to accommodate rough terrain or unusually long spans
Land Temporarily Disturbed	
Structure Work Area	ROW width x 200 feet per structure
Wire-Pulling and Tensioning Sites	ROW width x 500 feet for dead-end structure (two sites at all dead-end structures) ROW width x 500 feet for mid-span conductor and shield wire (approximately every 9,000 feet) 100 x 500 feet for fiber optic cable set-up sites (approximately every 18,000 feet)
Material Storage Yards	Located approximately every 30 miles Typical material storage yard area: approximately 20 acres
Staging Areas / Fly Yards	Located approximately every 5 miles. Typical fly yards/staging areas: approximately 7 acres
Batch Plant Sites	Located approximately every 15 miles Stand-alone temporary batch plants, estimated size: approximately 5 acres
Guard Structures	100 x 100 feet at road and existing electrical line crossings
Land Permanently Disturbed	
Structure Base[3]	Guyed lattice (tangent) - 500 square feet (100 square feet mast foundation + 4 x 100 square feet for anchors) Self Supporting Lattice (tangent) - 900 square feet (30 x 30 feet tower base)

[3] Structure types to be used in site-specific settings will be determined during engineering and design of the Agency Preferred Alternative.

TABLE 1 TYPICAL ±600 KV DC TRANSMISSION LINE DESIGN CHARACTERISTICS	
FEATURE	DESCRIPTION
	Self Supporting Lattice (angle) - 1,225 square feet (35 x 35 feet tower base) Self Supporting Lattice (dead-end) - 1,600 square feet (40 x 40 feet tower base) Tubular Steel Pole (tangent) - 40 square feet (7-foot diameter foundation) Tubular Steel Pole (dead-end/angle) - 100 square feet (two poles x eight-foot diameter foundations)
Regeneration Sites	Located approximately every 50 miles, most located on the transmission line ROW and each approximately 10,000 square feet (100 x 100 feet).
Access Roads	
Paved Roads	These roads are typically highways and state routes, and will be used for travel to existing and new dirt roads to access the ROW.
Dirt/Gravel Roads (no improvement)	Requires no improvement to dirt/gravel roads.
Dirt Road (with improvements)	Improvement of existing dirt roads 16 to 24 feet wide depending on terrain.
New Access Road (bladed)	Typically, 14 foot wide bladed surface with two to three foot berms or ditches on either side, but can be wider in steep and mountainous terrain because of cut and fill requirements according to ground slope.
Overland Access	Non-graded overland access (“drive & crush”) where terrain and soil conditions are suitable.
Electrical Properties	
Nominal Voltage	±600 kV DC
Nominal Capacity	3,000 MW (as measured at the Southern Terminal)
Circuit Configuration	DC Bi-Pole Bundled
Conductor Size	Approximately 1.5 inch diameter ACSR conductor bundled with three or four subconductors per pole.
Ground Clearance of Conductor	37 feet minimum at a conductor temperature of 176 degrees Fahrenheit
Notes: ACSR = aluminum conductor steel reinforced	

3.1.1 Structure Designs

The TWE Project ±600 kV DC transmission line will be constructed primarily with guyed lattice structures (Figure 1). Self supporting steel lattice and single shaft tubular steel poles (Figures 2 and 3) would be used in selective locations where engineering or other site-specific considerations determine that the guyed lattice steel structure is not appropriate. Table 2 indicates the general suitability of the transmission structure designs by characteristic settings. Figure 4 shows each structure design within a typical 250 foot-wide ROW.

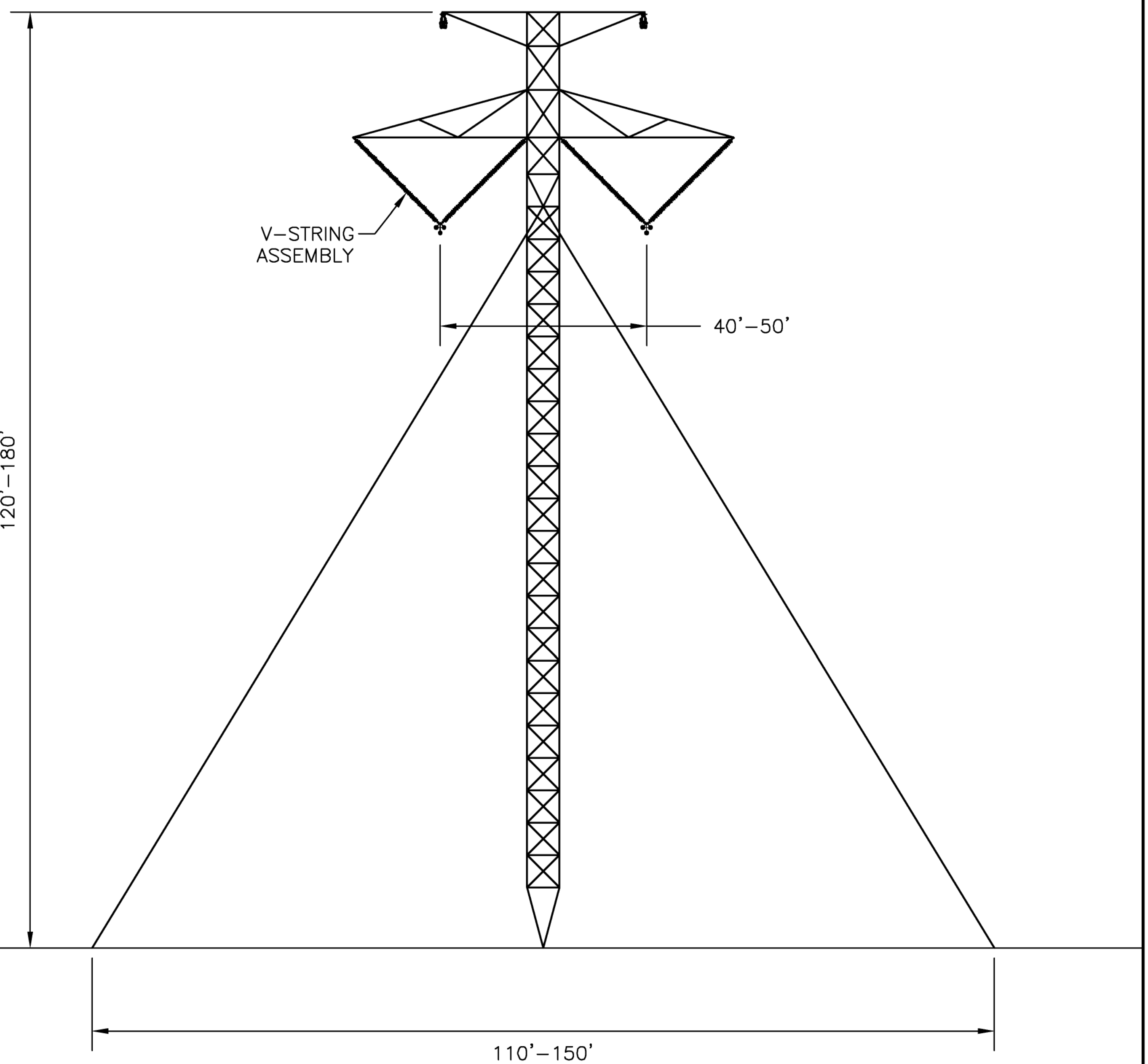
The guyed lattice structure shown on Figure 1 is the proposed tangent design for most locations due to its constructability and overall cost considerations. In addition to tangent structure configurations, specialized structures will be engineered wherever the line must change direction. Each angle structure will be individually designed, taking into consideration both the degree of the angle and site-specific geologic conditions, to withstand the increased lateral stress of conductors pulling in two different directions. Angle structures are stronger and have deeper foundations than tangent structures. The term ‘dead-end’ or ‘strain’ structure typically refers to a structure where the conductors are separated and connected together (electrically) by a jumper. These dead-end structures are typically placed at locations where the transmission line significantly changes direction.

The TWE Project will be designed in accordance with guidelines established by the Avian Powerline Interaction Committee (APLIC 1994, 2006).

TABLE 2 ±600 KV DC TRANSMISSION LINE DESIGN ALTERNATIVES POTENTIALLY USED IN CHARACTERISTIC SETTINGS

CHARACTERISTIC SETTING	GUYED STEEL LATTICE	SELF SUPPORTING STEEL LATTICE	TUBULAR STEEL POLE
Flat to Rolling Terrain	X		
Steep to Mountainous Terrain & Steep Side Slopes	*	X	X
Open Lands	X		
Agricultural Fields, Urban Areas		X	X
Highly constrained ROW			X
Line Angle 0-2°	X		
Heavier Line Angles and Dead-end Strain Structures		X	X

* Should helicopter erection of structures be preferred or required, guyed lattice steel structures may be utilized in steep to mountainous terrain as long as specific structure locations do not have excessively steep side slopes.



NOTES

1. DIMENSIONS SHOWN ARE FOR ILLUSTRATION PURPOSES ONLY.
2. TOWER OUTLINE AND BRACINGS ARE INDICATIVE ONLY.

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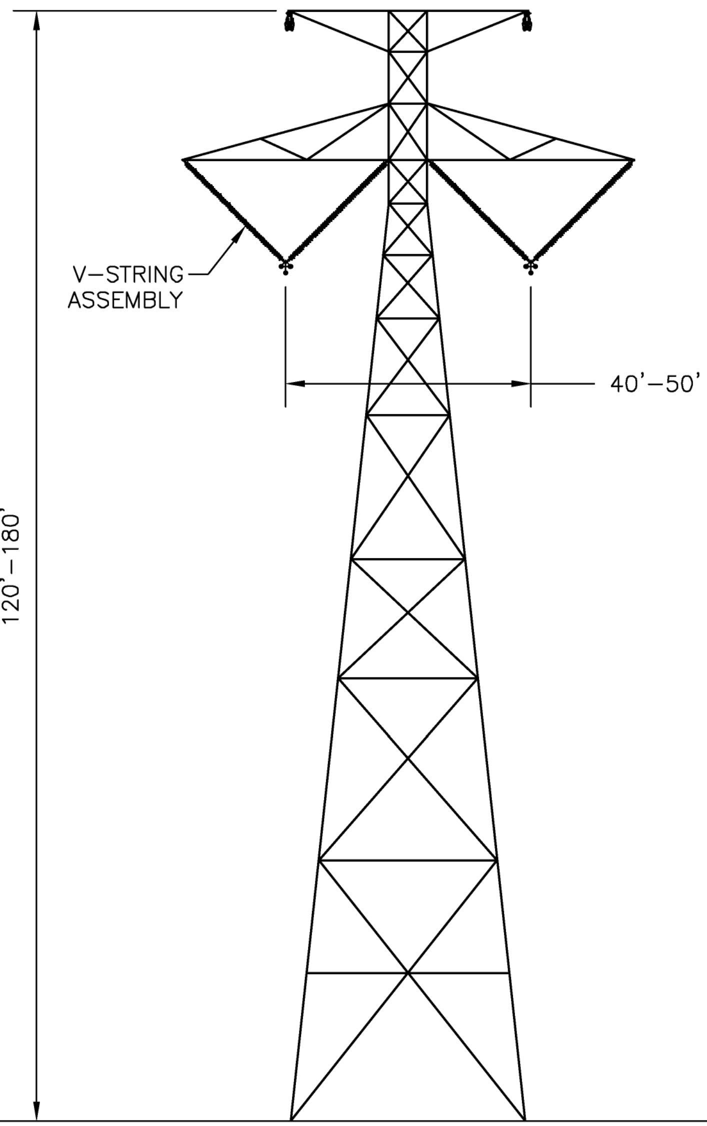
TRANSWEST EXPRESS TRANSMISSION PROJECT
FIGURE 1

TYPICAL ±600kV DC
GUYED V–STRING
LATTICE STRUCTURE



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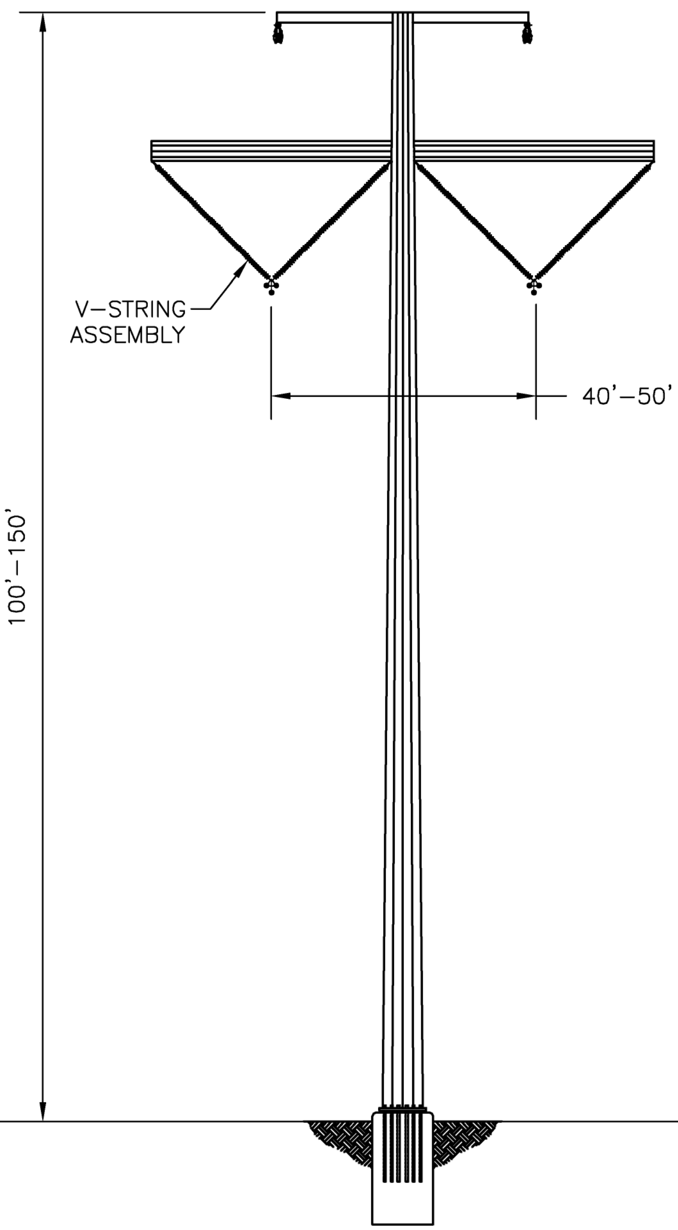
TRANSWEST EXPRESS TRANSMISSION PROJECT
FIGURE 2

TYPICAL ±600kV DC
SELF SUPPORTING LATTICE
V–STRING STRUCTURE



NOTES

1. DIMENSIONS SHOWN ARE FOR ILLUSTRATION PURPOSES ONLY.

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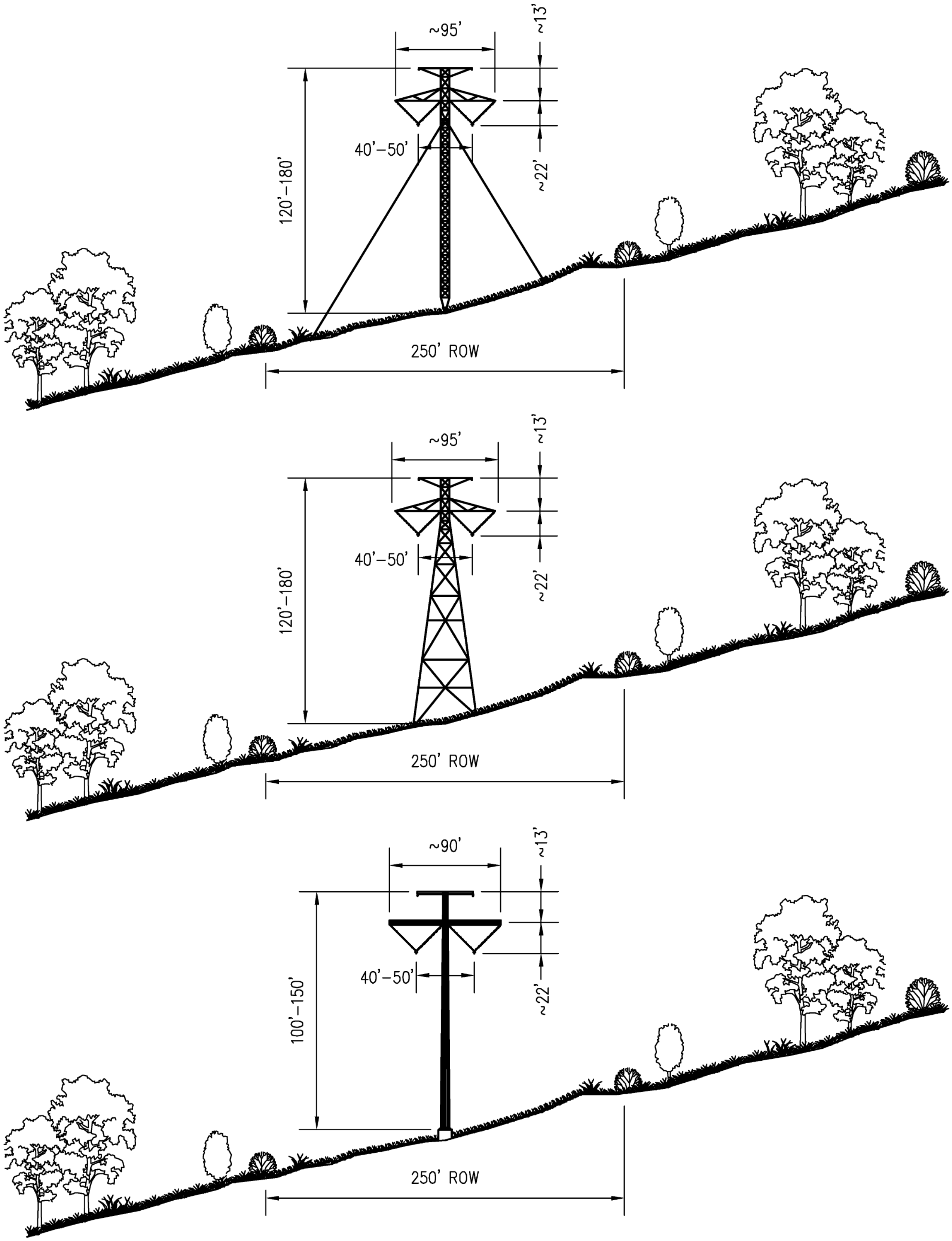
TRANSWEST EXPRESS TRANSMISSION PROJECT
FIGURE 3

TYPICAL ±600kV DC
TUBULAR STEEL POLE
V–STRING STRUCTURE



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TRANSWEST EXPRESS TRANSMISSION PROJECT
FIGURE 4

TYPICAL ROW CROSS SECTIONS
BY STRUCTURE TYPE

3.1.2 Structure Foundations

The guyed steel lattice towers will generally require one precast concrete support pedestal for the tower base and four anchors for guy cables. The typical precast concrete support pedestal will be three to six feet in diameter and four to six feet in depth. Due to site-specific characteristics, some foundations may require a cast-in-place reinforced concrete support pedestal. The anchors for attachment of the guy cables will be plate anchors or rock anchors depending on soil/rock conditions at each site.

Self supporting lattice towers will require four foundations with one foundation on each of the four corners (legs) of the lattice towers. The foundation diameter and depth will be determined during final design and are dependent on the type of soil or rock present at each specific site. Typically, the foundation for each leg of the structure will be a reinforced cast-in-place concrete drilled pier, with a typical diameter of three to four feet and a depth of approximately 12 to 25 feet. Foundations for dead-end and angles structures will be larger, typically ranging from five to eight feet in diameter and 20 to 50 feet in depth.

Tubular steel pole towers will require one cast-in-place foundation. These tubular steel towers will be installed on a single reinforced concrete pier with anchor-bolts connecting the tubular pole base plate to the foundation. The foundation diameter and depth will be determined during final design and are dependent on the type of soil or rock present at each specific site. Foundations for these structures will typically be six to ten feet in diameter and 20 to 60 feet in depth.

3.1.3 Conductors

<u>Design Characteristics.</u> The proposed conductor for the TWE Project ±600 kV DC transmission line is an ACSR (Aluminum Conductor Steel Reinforced) conductor approximately 1.5 inches in diameter. Each pole of the ±600 kV bipole[4] line will be composed of three or four subconductors in a triple-bundle or quad-bundle configuration. The individual conductors will be bundled in either a triangular configuration (triple-bundle) or a diamond configuration (quad-bundle) with spacing of approximately 18 inches between subconductors. The bundled configuration is proposed to provide adequate current carrying capacity and to provide a reduction in audible noise and radio interference as compared to a single large-diameter conductor. Each ±600 kV subconductor will have a non-specular finish[5].

<u>Ground Clearance Requirements and Guidelines.</u> Conductor phase-to-phase and phase-to-ground clearance parameters are determined in accordance with the NESC, ANSI C2, produced by the American National Standards Institute (ANSI). The NESC provides for minimum distances between the conductors and ground, crossing points of other lines and the transmission support structure and other conductors, and minimum working clearances for personnel during energized operation and maintenance activities. The clearance requirements for conductor heights above ground are based on the current and potential use of the land being crossed. The clearance requirements for vertical separation at crossings over existing transmission lines are governed by NESC 2007 Rule 233. In addition to the minimum NESC requirements, additional clearances or buffers are added to account

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[4] A bipole HVDC transmission line consists of two poles – positive and negative. A pole may consist of one conductor or multiple conductors (i.e., subconductors) bundled together.
[5] Non-specular finish refers to a “dull” finish rather than a “shiny” finish.

for additional safety, construction tolerances, wire movements, wire temperatures, and landowner or land use specific requirements.

The minimum ground clearance for the TWE Project ±600 kV DC conductor is 37 feet at a conductor temperature of 176 degrees Fahrenheit. For a ±600 kV DC transmission line, the minimum conductor heights will typically range from 37 feet for range lands to 50 feet or more above railroad tracks. Clearances above highways would typically be 40 to 50 feet. Lands with center pivot irrigation or lands that are aerially sprayed would typically use a minimum ground clearance of 37 feet. The exact clearance criteria for each type of land use and each type of facility being crossed will be determined during detailed design.

The clearance requirements for vertical separation at crossings over existing transmission lines are also governed by NESC 2007 Rule 233. In addition to the minimum NESC requirements, additional clearances or buffers are added to account for additional safety, construction tolerances, wire movements, differential wire temperatures, and utility specific requirements. The vertical separation typically ranges from approximately 25 feet for distribution and lower voltage lines to approximately 50 feet or more for 500 kV extra high voltage (EHV) or HVDC lines. The exact clearance criteria for each voltage class being crossed will be determined during detailed design.

Standard industry practice suggests that the higher voltage line would cross over the lower voltage line. This standard would be followed at the line crossing locations in coordination with each facility owner or manager. To optimize the crossing structure heights, the line crossing locations are typically at mid-spans of the lines being crossed and at right angles to each other. Depending on the terrain and heights of the facility being crossed, taller structures for the TWE Project transmission line may be required at the line crossing locations. Guard structures will be installed, if required, to protect underlying wires and structures during wire stringing operations. These structures intercept the wire should it drop below a conventional stringing height, preventing damage to underlying wires and structures. In addition to guard structures, during construction, the Contractor for the TWE Project will be required to coordinate with the owner or operator of the line being crossed to comply with outage and other utility-specific requirements.

Due to the static nature of DC electrical and magnetic fields, the proposed DC transmission line will not induce any current in oil and gas well heads. The HVDC transmission line will be sited such that oil or gas wellheads, and associated above ground facilities at the wellhead, will not be located on the transmission ROW. Additionally, a 250-foot buffer from oil and gas wellheads will be used as a siting criteria for locating the final centerline of the ±600 kV HVDC transmission line.

3.1.4 Insulators and Associated Hardware

As shown in Figures 1, 2, and 3, insulator assemblies for ±600 kV DC tangent structures will consist of two strings of insulators normally in the form of a "V." These insulator strings are used to suspend each conductor bundle (pole) from the structure, maintaining the appropriate electrical clearance between the conductors, the ground, and the structure. The V-shaped configuration of the ±600 kV DC insulators also restrains the conductor so that it will not swing into contact with the structure in high winds. Dead-end insulator assemblies for ±600 kV DC transmission lines will use an I-shaped configuration, which consists of insulators connected horizontally from either a tower dead-end arm or a dead-end pole in the form of an "I." Individual insulators for both suspension and dead-end applications will be composed of a single unit polymer (non-ceramic insulators).

3.1.5 Overhead Shield (Ground) Wires

To protect the ±600 kV DC transmission line from direct lightning strikes, two lightning protection shield wires, also referred to as ground wires, will be installed on the peaks or top arms of each structure. Electrical current from lightning strikes will be transferred through the shield wires and structures into the ground.

One of the shield wires will be composed of extra high strength steel wire approximately 0.5 inch in diameter. In short sections of the transmission line, near the terminals, this shield wire will also serve as the overhead electrode line connecting the AC/DC converter station to the ground electrode facility. The second shield wire will be an optical ground wire (OPGW) constructed of aluminum and steel, which will carry 36 to 48 glass fibers within its core. The optical ground wire will have a diameter of approximately 0.65 inch. The glass fibers inside the OPGW will facilitate data transfer between the two AC/DC converter stations at the Northern and Southern Terminals. The data will be used for system control and monitoring.

3.1.6 Grounding Rods

A grounding system will be installed at the base of each transmission tower and will consist of copper ground rods embedded in the ground in immediate proximity to the tower foundation, and connected to the tower by a buried copper lead. After the ground rods have been installed, the grounding will be tested to determine the resistance to ground. If the resistance to ground for a transmission tower is excessive, then counterpoise will be installed to lower the resistance. Counterpoise consists of a bare copper-clad or galvanized-steel cable buried a minimum of 12 inches deep, extending from one or more legs of a tower for approximately 100 feet within the ROW.

3.1.7 Minor Additional Hardware

In addition to the conductors, insulators, and overhead shield wires, other associated hardware will be installed on the structures as part of the insulator assembly to support the conductors and shield wires. This hardware will include clamps, shackles, links, plates, and various other pieces composed of galvanized steel and aluminum.

Other hardware not associated with the transmission of electricity may be installed as part of the Project. This hardware may include aerial marker spheres or aircraft warning lighting as required for the conductors or structures per Federal Aviation Administration (FAA) regulations.[6] Tower proximity to airports and tower height are the determinants of whether FAA regulations would apply based on an assessment of wire/tower strike risk. The Applicant does not anticipate that tower lighting will be required because proposed towers will be less than 200 feet tall and will be located to the greatest extent to avoid airport impacts. However, if special circumstances (e.g., a tall crossing) require structures taller than 200 feet, FAA regulations regarding lighting and marking will be followed.

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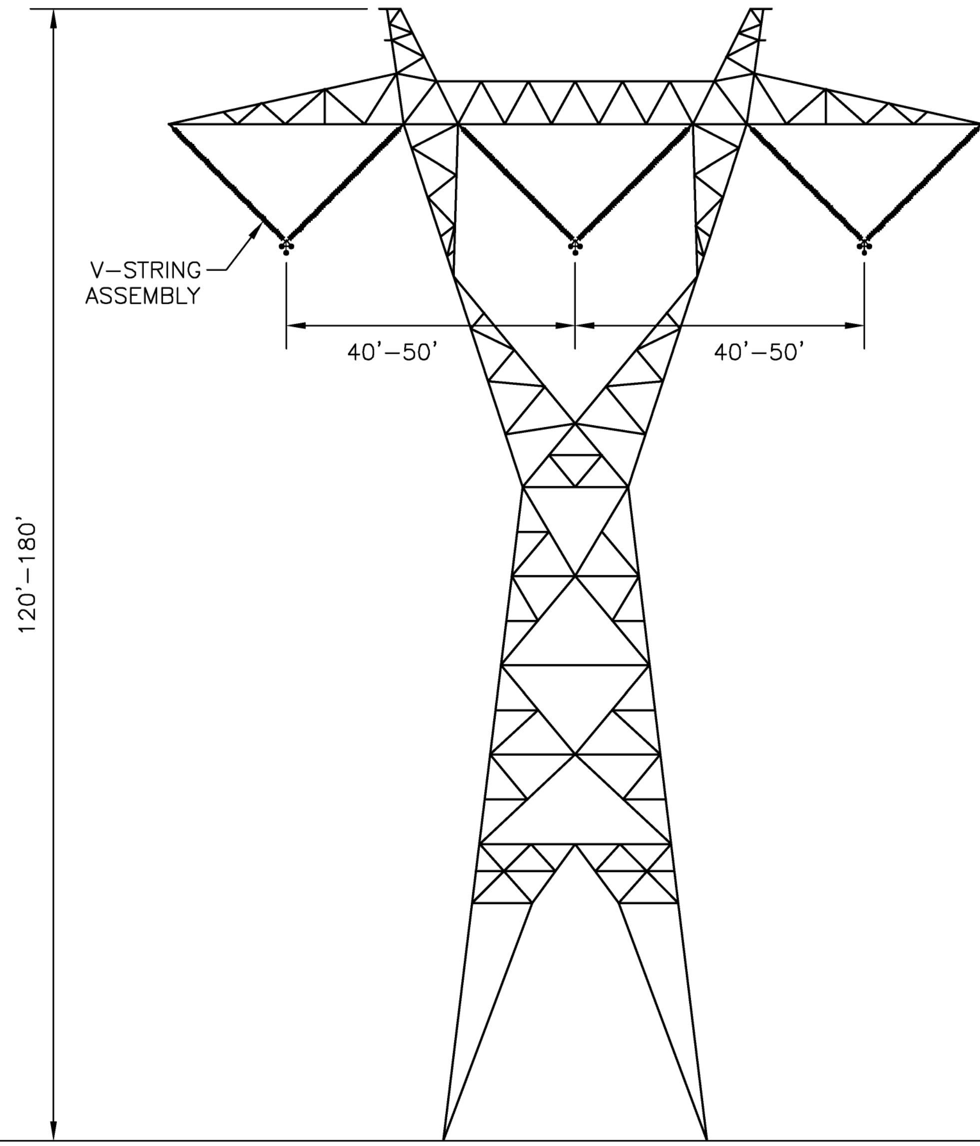
[6] U.S. Department of Transportation, Federal Aviation Administration, Advisory Circular AC 70/7460-1K Obstruction Marking and Lighting, August 1, 2000; and Advisory Circular AC 70/7460-2K Proposed Construction or Alteration of Objects that May Affect the Navigable Airspace, March 1, 2000.

3.1.8 Grid Interconnections

The TWE Project will need to connect to planned or existing 500 kV and 230 kV transmission grids in Wyoming and to existing 500 kV transmission grids in Nevada, near each terminal. Specific structure types are not known at this time and will be determined during final engineering and design. A typical self supporting lattice structure, used for a single circuit 500 kV AC line connection, is shown on Figure 5. Typical single circuit and double circuit 230 kV AC single pole structures are shown on Figure 6. The components for the 500 kV and 230 kV structures including foundations, conductors, insulators, and associated hardware, overhead shield (ground) wires, and grounding rods, are similar to those described for the ±600 kV DC transmission line.



NOTES

1. DIMENSIONS SHOWN ARE FOR ILLUSTRATION PURPOSES ONLY.
2. TOWER OUTLINE AND BRACINGS ARE INDICATIVE ONLY.

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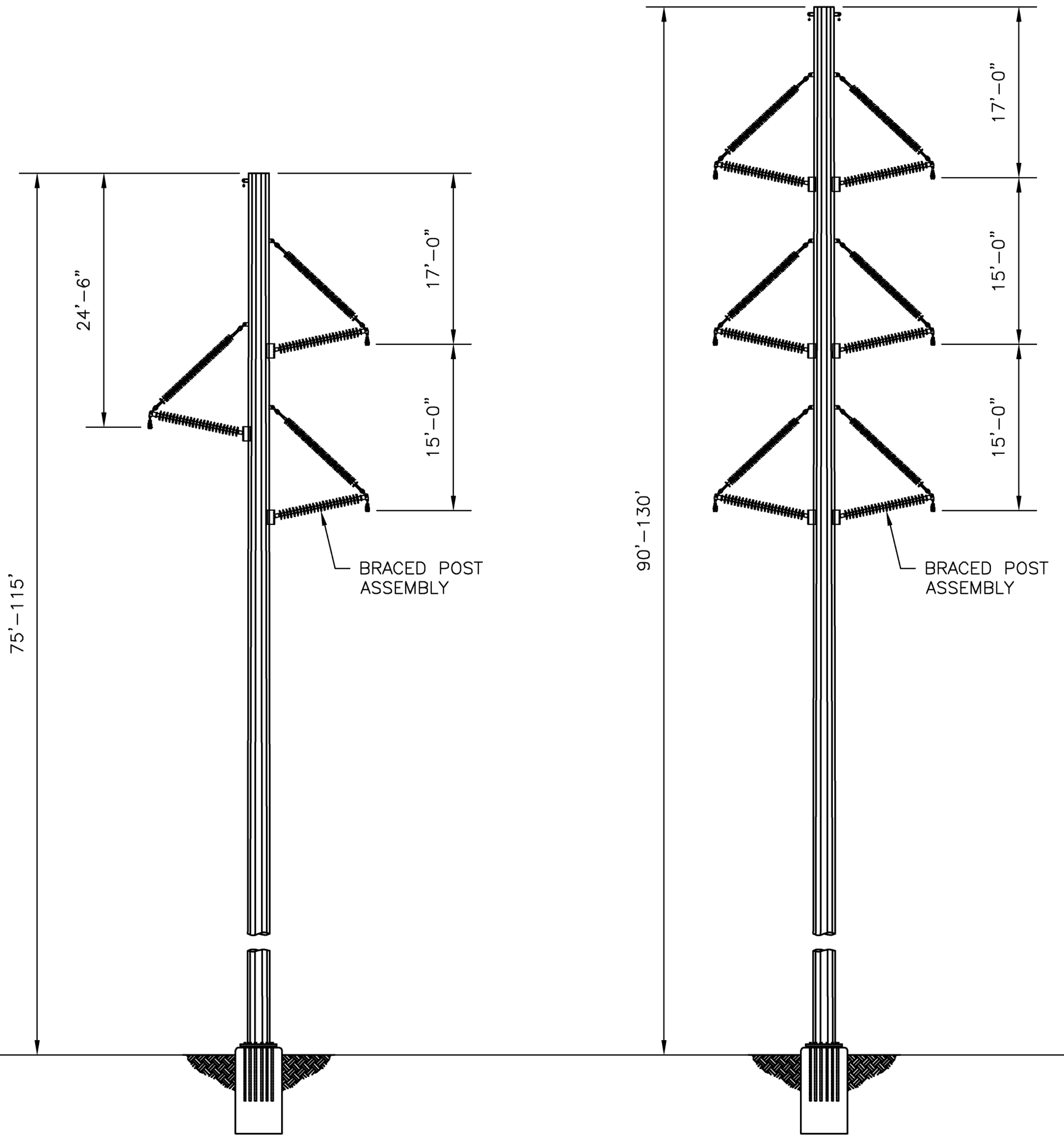
FIGURE 5

TYPICAL 500kV AC SINGLE CIRCUIT
SELF SUPPORTING
LATTICE STRUCTURE



NOTES

1. DIMENSIONS SHOWN ARE FOR ILLUSTRATION PURPOSES ONLY.

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FIGURE 6

TYPICAL 230kV AC SINGLE & DOUBLE CIRCUIT POLE STRUCTURE

3.2 Northern and Southern Terminals

The terminal stations will be designed to include the AC/DC converter station and an adjacent AC substation. The AC/DC converter station will include a ±600 kV DC switchyard, AC/DC conversion equipment, transformers, and multiple equipment, control, maintenance and administrative buildings. There will be two buildings to house the AC/DC conversion equipment, each approximately 200 feet long by 80 feet wide by 60 to 80 feet high. Additionally, there will be smaller buildings to house the control room, control and protection equipment, auxiliary equipment, and cooling equipment. The AC substations will be either a 500/230 kV substation (Northern Terminal) or a 500 kV substation (Southern Terminal). The AC substations will include a switchyard, transformers, control equipment, and control buildings. Figure 7 is a photograph of a representative AC/DC terminal (converter station and adjacent AC Substation).

FIGURE 7 TYPICAL AC/DC CONVERTER STATION

Table 3 summarizes the general design characteristics of the terminals.

TABLE 3 TYPICAL DESIGN CHARACTERISTICS OF TERMINALS	
FEATURE	DESCRIPTION
Northern Terminal	Six 500 kV AC line positions, two 500/230 kV transformer banks, twelve 230 kV line positions, two AC filter bank line positions, two reactive support device positions, two DC line positions with transformers, converter building(s), and AC and DC filter yards. The reactive support equipment will require other structures and building development within the proposed complex. Maintenance and storage facilities will be developed as required and as appropriate for this remote location. Certain assigned shift operators, maintenance staff, and site security staff may be on-site at all times, although no permanent residence(s) will be established. On-site fire protection and emergency/security staff will support operations and maintenance staff at the facility in accordance with state, county, and federal requirements.
Southern Terminal	Six 500 kV AC line positions, two 500 kV AC filter line positions, two DC line positions with transformers, converter building(s), and AC and DC filter yards. Maintenance and storage facilities will be developed as required and as appropriate for this remote location. Certain assigned shift operators, maintenance staff, and site security staff may be on site at all times, although no permanent residence(s) will be established. On site fire protection and emergency/security staff will support operations and maintenance staff at the facility in accordance with state, county, and federal requirements.

3.2.1 Northern Terminal

The Northern Terminal will consist of an AC/DC converter station (a ±600 kV DC switchyard and a converter building containing power electronics and control equipment), a 500/230 kV AC substation, and a 230 kV AC substation. The facilities will be located on private lands in Carbon County, Wyoming, approximately 2.5 miles southwest of the town of Sinclair, Wyoming. The Northern Terminal will connect to the existing Platte – Point of Rocks 230 kV line located within a mile of the terminal. The Northern Terminal will also connect to the planned Energy Gateway West and Gateway South 500 kV transmission lines being developed by PacifiCorp.

The Northern Terminal will require the following components:

- An AC/DC converter station approximately 30 acres in size.
- A 500/230 kV AC substation approximately 135 acres in size.
- A 230 kV AC substation approximately 40 acres in size.
- An electrical connection from the AC/DC converter station to the ±600 kV DC transmission line connecting to the Southern Terminal. All facilities for this connection are incorporated into the ±600 kV DC transmission line.
- Two electrical connections from the proposed single circuit Energy Gateway West 500 kV transmission line to the 500/230 kV substation. These connections will connect the Northern Terminal to both the Aeolus and Anticline substations via the Energy Gateway West 500 kV transmission line. These two connections may require 500 kV transmission facilities, assumed to be four miles total or less in length, to connect the 500/230 kV substation to the route of the Energy Gateway West 500 kV transmission line. Figure 5 shows a typical structure design for the 500 kV transmission line connections.

- Two electrical connections from the proposed single circuit Energy Gateway South 500 kV transmission line to the 500/230 kV Substation. These connections will connect the Northern AC/DC converter station to both the Aeolus and Mona Substations via the Energy Gateway South 500 kV transmission line. These two connections may require 500 kV transmission facilities, assumed to be four miles total or less in length, to connect the 500/230 kV substation to the route of the Energy Gateway West 500 kV transmission line. Figure 5 shows a typical structure design for the 500 kV transmission line connections.
- Two electrical interconnections to the existing Platte – Point of Rocks 230 kV line, which will be rerouted into and out of the 230 kV substation. This 230 kV connection is assumed to require four miles or less of double circuit 230 kV transmission line. Figure 6 shows a typical structure design for the 230 kV transmission line connections.
- Up to six electrical interconnections from proposed and planned generation facilities by 230 kV transmission lines. Figure 6 shows a typical structure design for the 230 kV transmission line connections.

Construction of the Northern Terminal is estimated to require approximately 520 acres. Approximately 250 acres of this area will be permanently dedicated for the AC/DC converter station and substations, terminal access road, transmission line structures, and interconnection line access roads. Approximately 205 acres will be fenced for the Northern Terminal. Approximately 275 acres are estimated to be temporarily disturbed for construction work areas, including land for storage and a concrete batch plant, transmission line structure work areas, and pulling, tensioning and splicing sites.

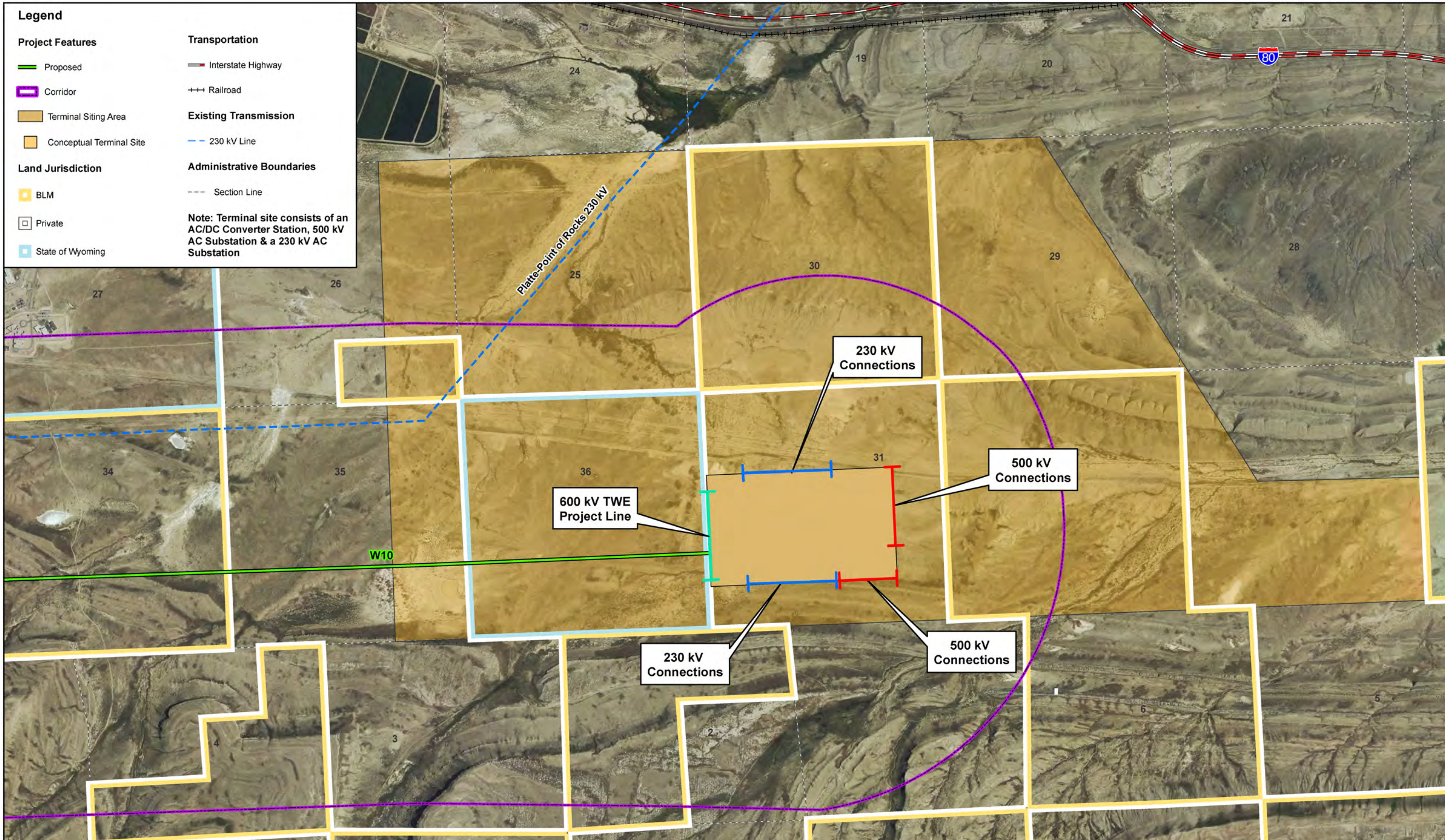
The general planned locations for the Northern Terminal and grid interconnections are shown on Map Exhibit 3. The location for the Northern Terminal site is proposed to be within the siting area shown. The final site location will be determined during final engineering and design. The criteria used in selecting the siting area and the final site location are:

- Land Ownership - use of private lands over public lands is preferable.
- Land Use - other current and planned land uses in the area, in particular other infrastructure that is being planned and permitted.
- Environmental Constraints - avoidance of sensitive resources, including sensitive wildlife habitats, cultural resource sites, wetlands, and major drainages.
- Topography - use of level dry land over more rugged terrain is preferable.
- Access to the TWE Project transmission line corridors coordinated with other existing and planned infrastructure and which minimize line crossings.
- Interconnections with existing, planned, and potential transmission lines such that line crossings are minimized, and conflicts with other existing and planned infrastructure are avoided.

Map Exhibit 3 illustrates a conceptual layout of the Northern Terminal and associated 230 kV and 500 kV connections to existing and planned facilities. The location of the Northern Terminal and the alignments of the 230 kV and 500 kV transmission line connections will be located within the proposed terminal siting area and will be determined during final design.[7]

Based on final ownership/operating agreements and interconnection contracts, it is possible that the 500/230 kV AC substation and/or the 230 kV AC substation could each be broken into two separate facilities. The total required acreage of the separate 500/230 kV AC substation(s) and the 230 kV AC substation(s) would not be greater than the 175 acres (135 plus 40) described above. The total fenced acreage for the Northern Terminal would be 205 acres in either one contiguous facility or 70 acres in one location and an additional 135 acres in a remote location. Land outside of this area would be used for access roads. Terminal access will require an estimated ten acres of permanent disturbance. With the exception of the associated interconnection lines, no other permanent development outside of the fenced area for this facility is anticipated.

[7] The three major components of the Northern Terminal (AC/DC converter station, 500/230 kV AC substation, and 230 kV AC substation) are planned to be co-located and contiguous. Although each of these three components are stand-alone facilities and could be located on separate parcels connected together by short "transmission" lines, it is common practice and preferable for the AC/DC converter station and 500/230 kV AC substation(s) to be located adjacent to each other. Although it is also preferable to locate the 230 kV AC substation next to the 500 kV AC substation, depending on the availability of space and other constraints in this area, these stand-alone facilities could be separated by a distance of up to two miles.



Map Exhibit 3

Conceptual Northern Terminal & Grid Interconnections

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3.2.2 Southern Terminal

The Southern Terminal will consist of an AC/DC converter station (a ±600 kV DC switchyard and a converter building containing power electronics and control equipment) and a 500 kV AC substation. The facilities will be located in the Eldorado Valley on private or BLM administered land, approximately 15 miles south of Boulder City, in Clark County, Nevada. The Southern Terminal will connect to all four of the existing 500 kV substations located at the Marketplace Hub. These four substations are the Eldorado, Marketplace, Merchant, and McCullough substations.

The Southern Terminal will require the following components:

- An AC/DC converter station approximately 30 acres in size.
- A 500 kV AC substation approximately 110 acres in size.
- An electrical connection from the AC/DC converter station to the ±600 kV DC transmission line connecting to the Southern Terminal. All facilities for this connection are incorporated into the ±600 kV DC transmission line.
- Two electrical connections from the existing Mead – Marketplace 500 kV transmission line to the new 500 kV AC Substation. These connections will connect the Southern Terminal to both the Mead and Marketplace substations via the existing Mead – Marketplace 500 kV transmission line. These two connections may require 500 kV transmission facilities, assumed to be five miles total or less in length, to connect the new 500 kV AC substation to the existing Mead – Marketplace 500 kV transmission line. Figure 5 shows a typical structure design for the 500 kV transmission line connections.
- Construction of a 500 kV transmission line from the new 500 kV AC substation to the Eldorado substation. This single circuit 500 kV transmission line is estimated to be five miles in length or less. Figure 5 shows a typical structure design for the 500 kV transmission line connections.
- Construction of a 500 kV transmission line from the new 500 kV AC substation to the McCullough substation. This single circuit 500 kV transmission line is estimated to be five miles in length or less. Figure 5 shows a typical structure design for the 500 kV transmission line connections.
- Although not anticipated at this time, one or more of the existing 138/230 kV lines within the Proposed Terminal Siting Area may need to be re-routed/re-configured to accommodate the Southern Terminal due to congestion within the area. If necessary, this reroute or reconfiguration of 138/230 kV transmission line facilities is not anticipated to impact more than a total of five miles of line. Figure 6 shows a typical structure design for the 230 kV transmission line connections.

Construction of the Southern Terminal on private land is estimated to require approximately 555 acres whereas the terminal construction on BLM land is estimated to require approximately 750 acres. Approximately 230 to 260 acres of this area will be permanently dedicated for the AC/DC converter station and switchyards, terminal access road, transmission line structures, and interconnection line access roads. Approximately 140 acres will be fenced for the Southern Terminal. Approximately 335 acres on the private land site and 500 acres of the BLM land site are estimated to be temporarily disturbed for construction work areas, including land for storage and a concrete batch plant, transmission line structure work areas, and pulling, tensioning and splicing sites.

The general planned location for the Southern Terminal and grid interconnections are shown on Map Exhibit 4, which illustrates a conceptual layout of the Southern Terminal and associated 500 kV connections to existing substations. The location of the Southern Terminal and the alignments of the 500 kV transmission line connections will be located within the terminal siting area and will be determined during engineering and design.[8]

Terminal access on the private land site and BLM land site will require an estimated 15 and 20 acres of permanent disturbance, respectively. With the exception of the associated interconnection lines, no other permanent development outside of the fenced area for this facility is anticipated.

3.3 Ground Electrode Systems

Two ground electrode facilities are proposed, one connecting to the Northern Terminal and one connecting to the Southern Terminal. The general proposed siting area for the northern ground electrode facility is termed ‘Separation Flat’ and shown on Map Exhibit 5. The proposed siting area for the southern ground electrode facility is termed ‘Mormon Mesa-Carp Elgin Road’ and shown on Map Exhibit 6.[9] The siting and site selection criteria are described in section 4.4.2. The location of the ground electrode systems within the siting areas and the layout of the wells and control facilities will be defined during final engineering and design. Once construction is completed, approximately 0.5 of an acre, or less, near the center of the electrode containing the control house will be fenced. Agricultural land uses outside the fenced area such as grazing and cultivated crops would be permissible.

These two ground electrode facilities will be built, each within approximately 100 miles of the Northern and Southern Terminals, to establish and maintain electrical current continuity during normal operations, and immediately following an unexpected outage of one of the two poles (or circuits) of the ±600 kV DC terminal or converter station equipment.

Each ground electrode facility will consist of a network of approximately 60 deep-earth electrode wells arranged along the perimeter of a circle expected to be about 3,000 feet in diameter. All wells at a site will be electrically interconnected and wired to a small control building via low voltage underground cables. A typical site plan for a ground electrode system is shown in Figure 8 and a photograph of a typical above ground facility is provided in Figure 9. A low voltage electrode line will be required to connect the ground electrode facilities to the AC/DC converter stations. To the

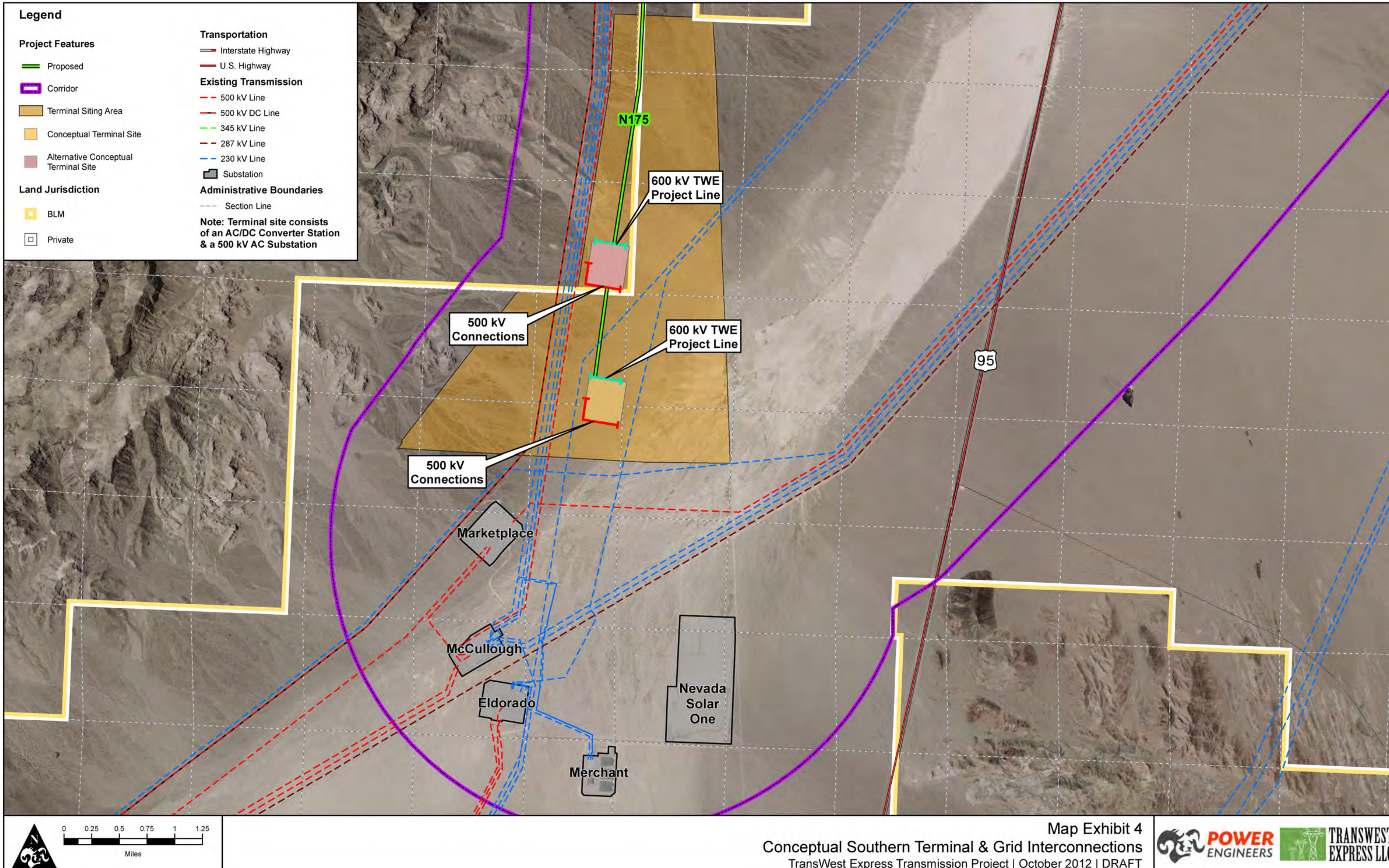
[8] The two major components of the Southern Terminal (AC/DC converter station and the 500 kV AC substation) are planned to be co-located and contiguous. Although these two components are stand-alone facilities and could be located on separate parcels connected together by short “transmission” lines, it is common practice and preferable for the AC/DC converter station and 500 kV AC substation to be located adjacent to each other.

[9] Map Exhibits 5 and 6 show both the proposed and alternative ground electrode sites and siting areas. See Section 4.2.2 for discussion of siting criteria and alternative siting areas.

extent practical, the overhead electrode line will be co-located on the ±600 kV DC structures in the overhead shield wire position. Where the electrode line diverges from the ±600 kV DC transmission line, it will be located on single pole structures, similar to those used for a modified 34.5 kV/69 kV distribution transmission line, built within a separate 50-foot-wide ROW. Figure 10 shows a typical single pole structure design that would be used for the overhead electrode line.

During a DC transmission disturbance where one pole becomes inoperable, the ground electrodes will carry a short-term large current that was previously flowing in the inoperable pole. The electrodes will be sized and designed to disperse this current into the ground at levels which are safe for people and animals in the vicinity. Such contingency conditions that result in high ground electrode currents are most often the result of an unexpected outage on the transmission line or equipment in the AC/DC converter station. The high current operation of the ground electrode facilities and the use of the earth as a return path is limited to unexpected emergency conditions and typically only operated for 10 minutes to less than an hour following the loss of a pole. For planning and preliminary engineering purposes, 12 to 16 unexpected disturbances resulting in the loss of a pole are anticipated on a yearly basis. Although the ground electrode facilities will be designed to operate at high current levels for up to 200 hours per year, typical yearly use at high currents is expected to be less than 30 hours per year.

The use of these ground electrode facilities allows system operators to maintain a portion of the TWE Project's power transmission capacity to support power network reliability. This feature will allow critical time for network operators to determine the extent of the electrical disturbance and reconfigure the transmission and generation systems into a more stable configuration that minimizes disruption of customer loads.



Map Exhibit 4

Conceptual Southern Terminal & Grid Interconnections

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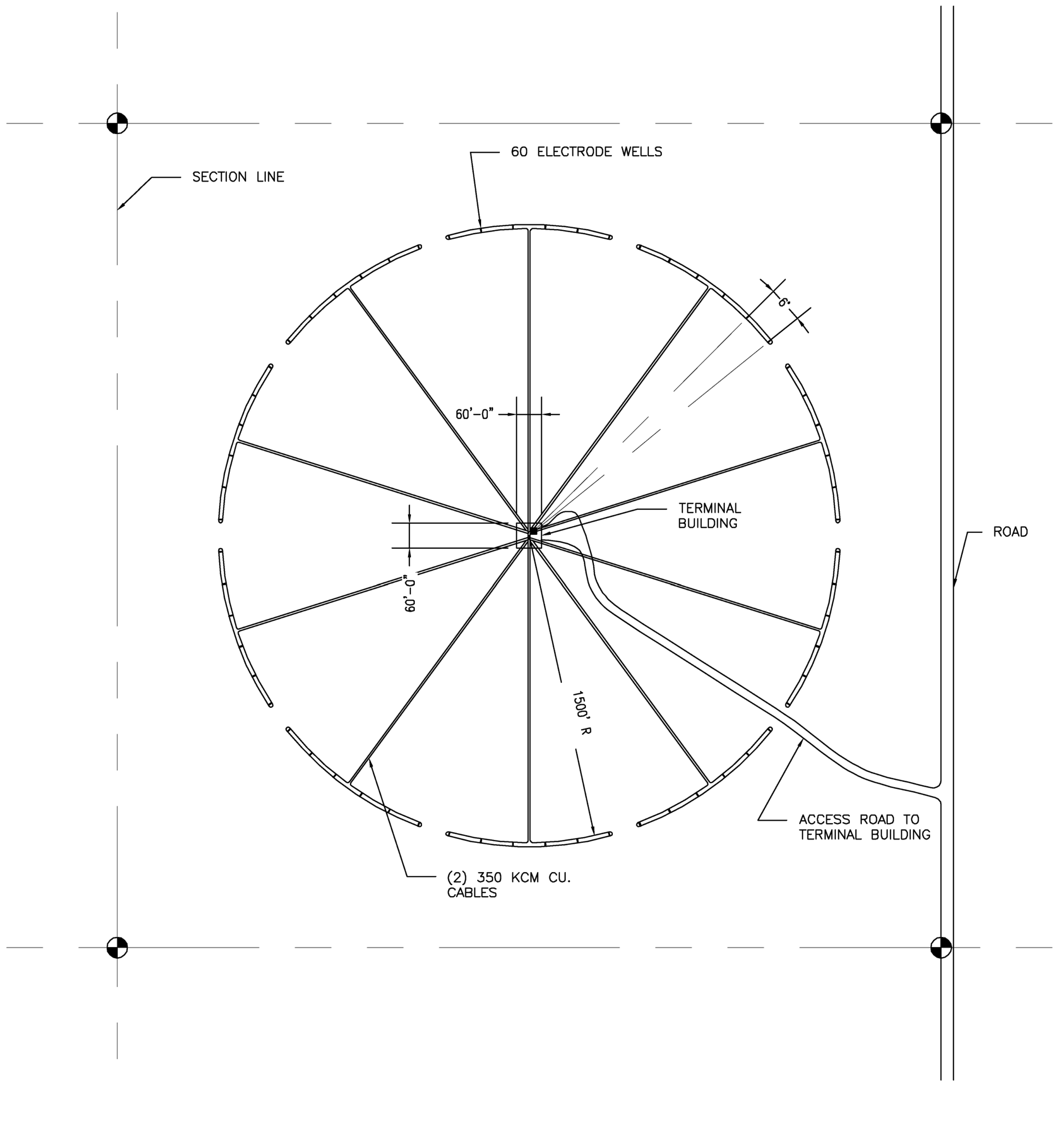

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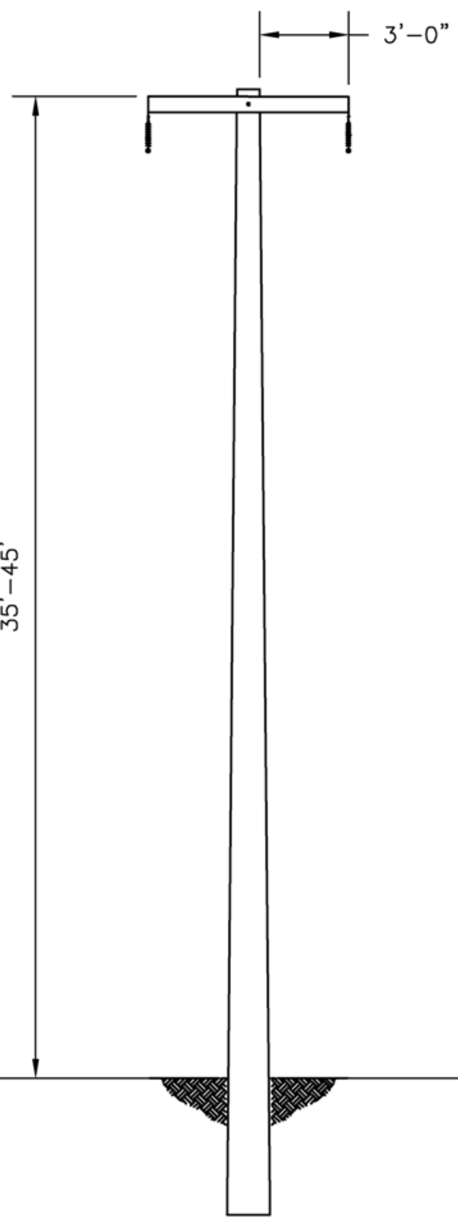
FIGURE 8

TYPICAL SITE PLAN FOR
GROUND ELECTRODE SYSTEM

FIGURE 9 TYPICAL ABOVE GROUND CONSTRUCTION AT THE GROUND ELECTRODE FACILITY



NOTES

1. DIMENSIONS SHOWN ARE FOR ILLUSTRATION PURPOSES ONLY.

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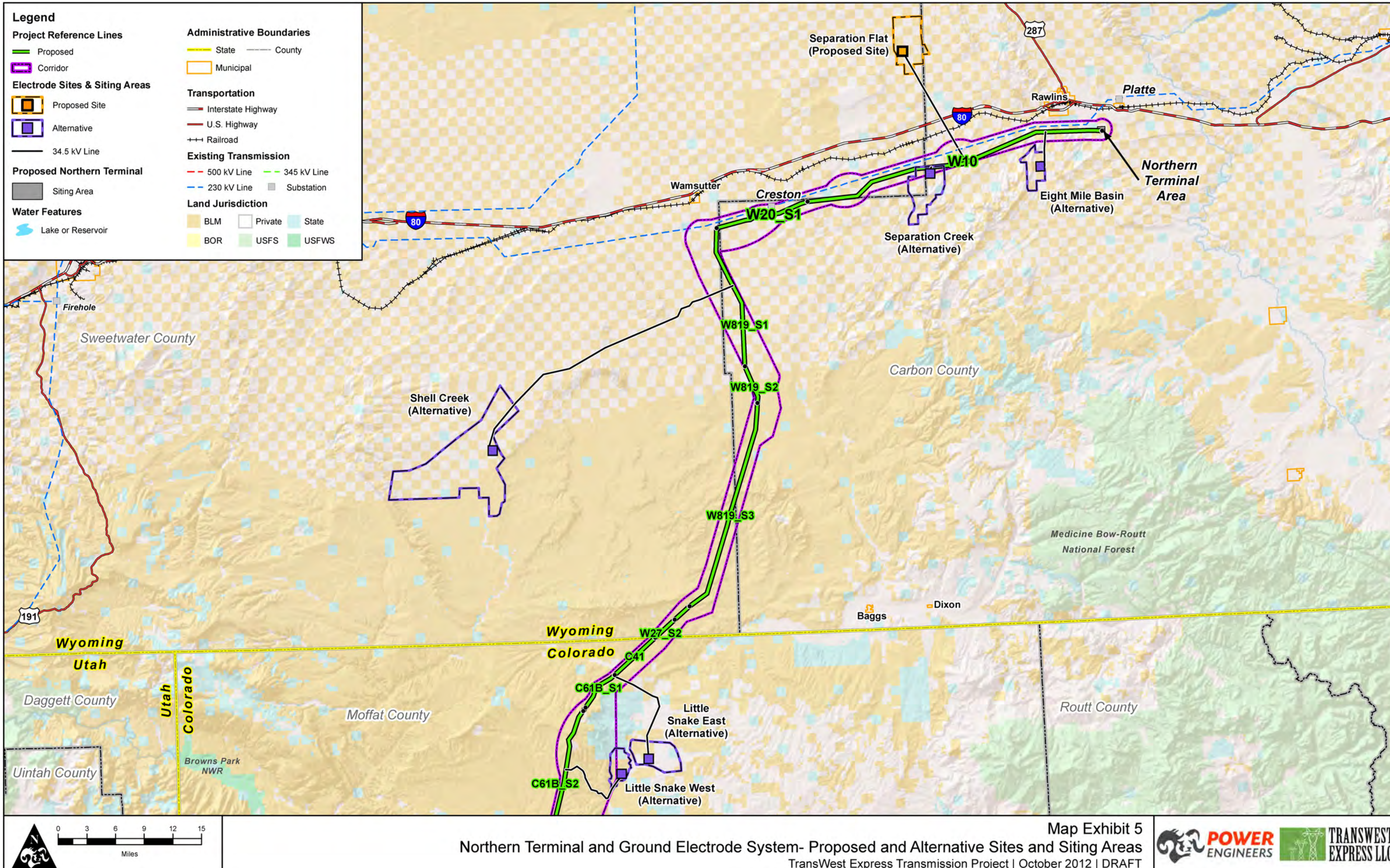
FIGURE 10

TYPICAL POLE STRUCTURE FOR OVERHEAD ELECTRODE LINE



Map Exhibit 5

Northern Terminal and Ground Electrode System- Proposed and Alternative Sites and Siting Areas

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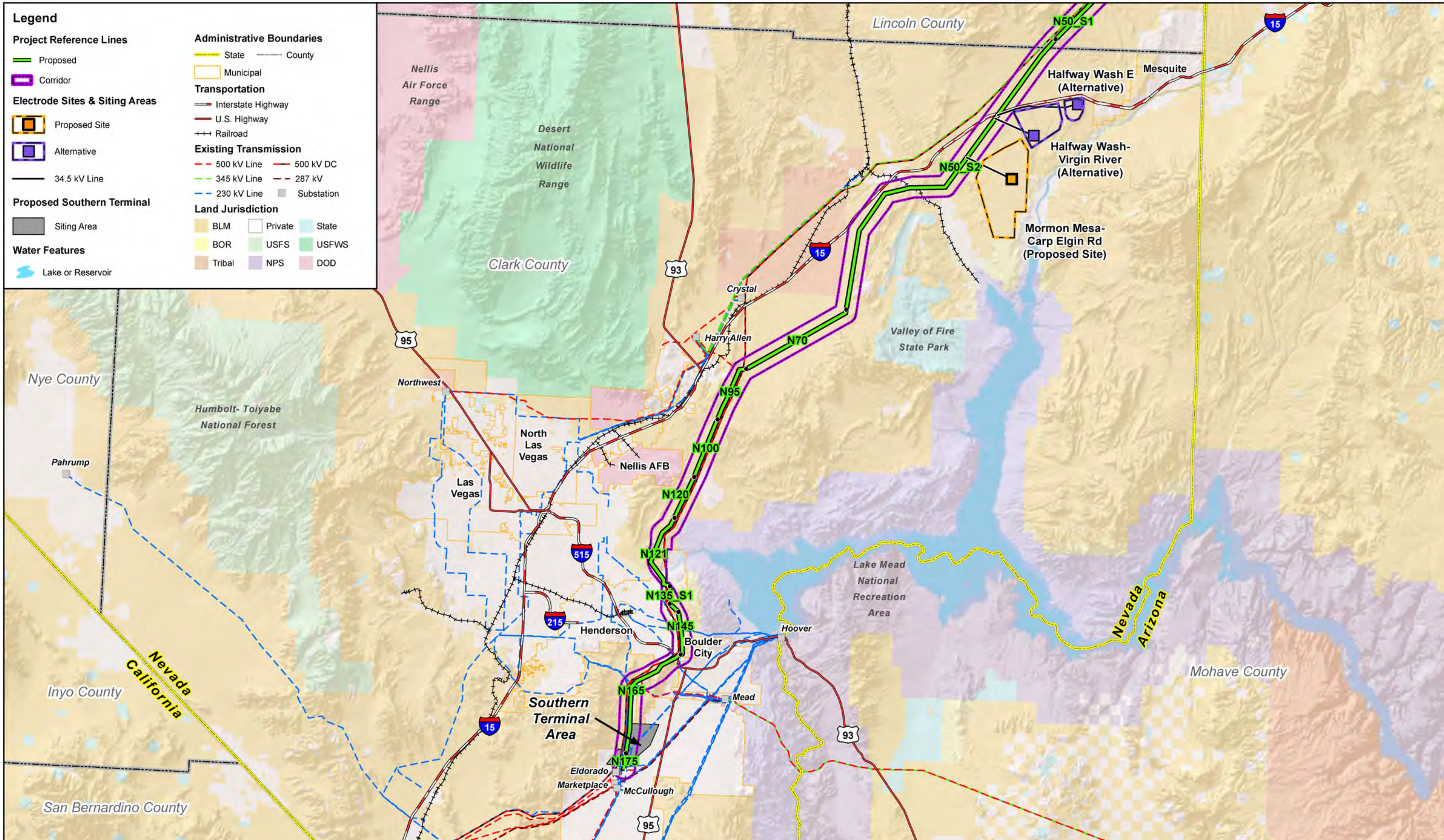

Map Exhibit 6

Southern Terminal and Ground Electrode System- Proposed and Alternative Sites and Siting Areas

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3.4 Communications System

The TWE Project will require a number of critical telecommunications support subsystems. These systems will be configured and designed to support the overall availability and reliability requirements for the operation of the HVDC terminal facilities and supporting substations. To provide secure and reliable communications for the control system real-time requirements, protection and day-to-day operations and maintenance needs, a mix of telecommunications systems will be used. The primary communications for protection and control will be provided via the one OPGW installed in the shield wire position on the transmission line. For redundancy purposes, a secondary communications path will be provided via existing or expanded/upgraded microwave systems or existing alternate buried fiber paths in the TWE Project region.

In addition to protection and control, the communications system will be used for Supervisory Control and Data Acquisition (SCADA). The SCADA system is a computer system for gathering and analyzing real time data which is used to monitor and control the substation (e.g., transformers and transmission lines), and auxiliary (e.g., pumps and cooling systems) equipment. A SCADA system gathers information, such as the status of a transmission line, transfers the information back to a central site, alerting the central site that the line has opened, carrying out necessary analysis and control, such as determining if outage of the line is critical, and displaying the information in a logical and organized fashion.

The primary communications will be an all-digital fiber system with repeater/regeneration facilities utilizing the OPGW located on the transmission line structures. The optical data signal degrades with distance as it travels through the optical fiber cable. Consequently, signal regeneration sites are required to amplify the signals if the distance between stations or regeneration sites exceeds approximately 50 miles. In total, approximately 15 to 20 regeneration sites will be required for the proposed TWE Project. In most cases, the regeneration communication sites will be located within the transmission line ROW and will typically be 100 feet by 100 feet in size. Figure 11 shows a typical communications regeneration site. The Applicant may also contract with third parties for the sale and use of excess fiber optic capacity. No additional facilities are anticipated for third party use of excess fiber optic capacity.

The secondary communications path for the TWE Project will be provided either by a private Project microwave system or purchasing/leasing capacity on existing utility dedicated communication networks within the TWE Project region.

If required, a private microwave system will be structured to utilize existing developed communications sites, access roads and utility held sites to the maximum extent possible. A small number of new microwave sites may be required for the TWE Project. As a microwave system requires line-of-site communications, the number and location of microwave sites will be determined as engineering progresses. A typical microwave communication site is less than 100 feet by 100 feet, and consists of a fenced enclosure that contains a small building for the communications equipment and a tower for mounting the microwave antenna(s). The microwave tower may be 50 feet to 150 feet high to meet the line-of-site communications requirement. In addition, multiple antennas may be mounted on the microwave tower depending upon the communications needs. In some cases, such as very remote locations with limited access to a reliable power supply, a small back-up generator may be required.

To facilitate mobile communications along the transmission line route for transmission line patrol, inspection, routine maintenance and emergency operations, a mobile ultra high frequency (UHF)/very high frequency (VHF) radio communications system will be implemented. For planning purposes, UHF/VHF radio equipment, towers, antennae and repeaters are assumed to be installed at each regeneration station.

FIGURE 11 COMMUNICATIONS REGENERATION SITE

3.5 Proposed TWE Project Construction Practices

This section describes the construction practices that will be used for the proposed TWE Project, including the ±600 kV DC transmission line; northern and southern terminals; ground electrode systems; and communications systems. Construction activities are described in the following sections:

- Section 3.5.1 – Pre-construction activities to be completed prior to construction commencing.
- Section 3.5.2 – Construction activities for the ± 600 kV DC transmission line and associated access roads.
- Section 3.5.3 – Construction activities for the northern and southern terminals.

- Section 3.5.4 – Construction activities for the northern and southern ground electrode systems.
- Section 3.5.5 – Construction activities for the communications system.
- Section 3.5.6 – Post construction clean-up and restoration.
- Section 3.5.7 – Special construction methods to be used in specific, sensitive locations, including blasting and helicopter construction techniques; roadless construction methods in IRAs; and construction techniques applicable to sensitive water resource areas.
- Section 3.5.8 – Water use during construction.
- Section 3.5.9 – TWE Project construction schedules, manpower, and equipment requirements.

3.5.1 Pre-Construction Activities

Prior to construction, the Applicant will obtain all applicable federal, state, and local permits; acquire easements and ROW grants for the TWE Project facilities; conduct geotechnical surveys and testing; and conduct pre-construction engineering and environmental surveys.

3.5.1.1 Permitting

The Applicant will acquire all federal, state, and local permits, licenses and agreements. A list of applicable permit requirements will be provided through the NEPA process and incorporated into the Construction, Operation, and Maintenance Plan (COM Plan) for the TWE Project. The TWE Project will necessitate crossings of existing electrical transmission lines, U.S. and State Highways, and railroads. The proposed line crossings will be coordinated with the appropriate entity and TransWest will obtain all required licenses, permits, or agreements.

3.5.1.2 ROW and Property Rights Acquisition

The Applicant will acquire ROWs or properties necessary to construct, operate, and maintain the TWE Project. New ROWs will be acquired for the transmission line(s) through a combination of ROW grants and easements with various federal, state, and local governments; other companies (e.g., utilities and railroads); and private landowners. Property owners affected by the TWE Project would initially be contacted by a realty agent who would explain the steps involved in site selection, property rights acquisition, and construction. A realty agent would request permission (for workers or Contractors) to enter the property to conduct engineering and environmental surveys and studies. Landowners will be contacted early in the process to obtain right-of-entry for surveys. Each landowner along the final centerline route will be contacted to explain the Project and to secure right-of-entry and access to the ROW.

Studies will be conducted to select structure sites, based on engineering design criteria, terrain, geologic investigations, and property owner input regarding land use and how to minimize potential impacts to properties. Geotechnical drilling will be required at some sites. Property owners will be compensated for damages to crops, fences, and other property caused by surveys and studies.

Property rights, in the form of perpetual easements or ROW, will be needed to construct, operate, and maintain the transmission line. Land for the Northern and Southern Terminals, substations, series compensation (as may be required for System Alternatives 2 and 3; see Section 4.3), and regeneration stations will be obtained in fee simple where located on private land. Easements and fee simple properties will be purchased through negotiations with landowners based on independent appraisals. Independent appraisals are used to determine the fair market value of the easement or property. Every effort will be made to acquire easements and properties through landowner negotiations to obtain an agreement, which is fair and reasonable to both parties. For transmission line easements, the landowner will retain title to the land and may continue to use the property in ways that are compatible with the transmission line. If in place of TransWest, Western were to acquire the private land property rights for the Project, it will do so in accordance with the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970.

Federal and state laws enable public agencies, and in some cases private parties, to acquire property rights for facilities to be built in the public interest. If a negotiated agreement cannot be reached, easements can be acquired through eminent domain (condemnation) proceedings. Through the eminent domain process, a court determines the compensation to be paid to the property owner(s).

3.5.1.3 Geotechnical Surveys and Testing

Prior to construction of the TWE Project, ground-based land surveys will be required at soil boring locations required for geotechnical investigations.

Geologic evaluation and geotechnical investigations will be performed as a part of general construction activities to evaluate potential geologic and geotechnical hazards and to determine specific requirements (ground conditions, soil types, depth to rock, depth to water, soil strength properties, etc.) for foundation design and construction. The work will be completed in time to develop final engineering specifications necessary for construction.

Geological evaluation will occur at generally the same time as geotechnical investigations, and will be a part of the final geotechnical report. For this activity, an engineering geologist will evaluate fault lines, landslide prone areas, steep slopes, and unstable soils to identify potential hazards, primarily at structure sites. Geologic review and evaluation will also be performed in the immediate vicinity of structure sites, and for access roads crossing steep slopes and unstable soils. The primary purpose of the geologic evaluation is to identify potential hazards with sufficient lead time to evaluate options for avoiding or mitigating potential hazards. The Project geotechnical engineer and geologist will prepare a report including recommendations for any necessary relocation of structure sites or roads in potentially hazardous areas. In the event that a structure site cannot be relocated, the geotechnical report will also specify construction methods designed to stabilize the site as well as any adjacent areas that might pose a hazard to the main site. These recommendations will be incorporated into the COM Plan including construction details for grading, drainage, and specialized slope treatments. The Contractor will implement the plans. All geologic/geotechnical field studies required will be coordinated with the appropriate land management agencies or private landowner and the appropriate permits will be obtained by the Applicant.

To determine proper structure foundation requirements, geotechnical investigations will be performed in the field to evaluate the strength and bearing capacity of site soils. This study will entail a core drilling program at structure site locations along the Agency Preferred Alternative. At sampling sites, borings will be extracted from which soil and/or bedrock material samples will be taken for laboratory testing and analysis. Soil borings are typically six to eight inches in diameter and as much as 70 feet deep. Soil borings are commonly taken at structure site locations at intervals of approximately one mile.

Soil borings will be performed with rubber tired or low impact drill rigs using approved access routes and methods in accordance with the appropriate land management agency or private landowner requirements, and applicable mitigation measures. Equipment typically used for geotechnical evaluations includes a drill rig, water truck, and 4-wheel drive support vehicles. The average estimated drilling time at each site is approximately one-half day. Work areas are typically 40 feet by 40 feet in size (1,600 square feet/0.37 acre).

Surface disturbances may occur at the structure site drill locations caused by parking, use of equipment, and associated field crew activities in the work area. Water may be used during the drilling process and a small amount of water may exit the drill holes. Following the completion of drilling at each site, soil boring holes will be backfilled with the drilled materials. Any remaining material would be spread at the site. The area of excess soil spreading will be small, and typically will not exceed 10 feet by 10 feet in size. No open holes will be left unattended and all holes will be backfilled prior to leaving the site.

Any geotechnical investigations involving ground disturbance on federal lands prior to the issuance of the TWE Project ROW grants may require additional authorizations. TransWest will apply for and obtain all necessary federal, state, and local authorizations.

3.5.1.4 Pre-Construction Surveys and Flagging

Pre-construction engineering surveys will be conducted to identify the transmission line ROW centerline and width, structure sites, vegetation clearance boundaries, property boundaries, ground profiles, access routes, temporary work areas, and stream crossings.

Pre-construction environmental surveys will be conducted, as required by permitting agencies, for the identification, flagging, and avoidance of sensitive resources. Requirements for environmental pre-construction surveys will be documented in the Final Environmental Impact Statement (FEIS) and the regulatory agencies' decision documents and stipulations. Investigations may include, but are not limited to: (1) desert tortoise and greater sage-grouse surveys; (2) rare and sensitive plant surveys; (3) noxious weed surveys; (4) cultural resource surveys; and (5) wetlands delineations in accordance with requirements for the Clean Water Act (CWA), Section 404 permit. Section 3.7 identifies the Applicant-committed environmental mitigation measures, including pre-construction surveys for sensitive resources.

3.5.2 Transmission Line Construction

The following sections detail the transmission line construction activities associated with the proposed ±600 kV DC transmission line and access roads. The general sequence of transmission line construction includes: construction of access roads; clearing of ROW and temporary work areas clearing; installation of foundations; assembly and erection of structures; installing shield wires and conductors; installing ground rods/counterpoise; and site cleanup and reclamation. Typical transmission line construction activities and sequencing are depicted in Figures 12 and 13. Various construction activities will occur during the construction process, with several construction crews operating simultaneously at different locations. Section 3.5.9.3 summarizes the types and quantities of equipment to be used for the transmission line construction.

3.5.2.1 Access Road Construction

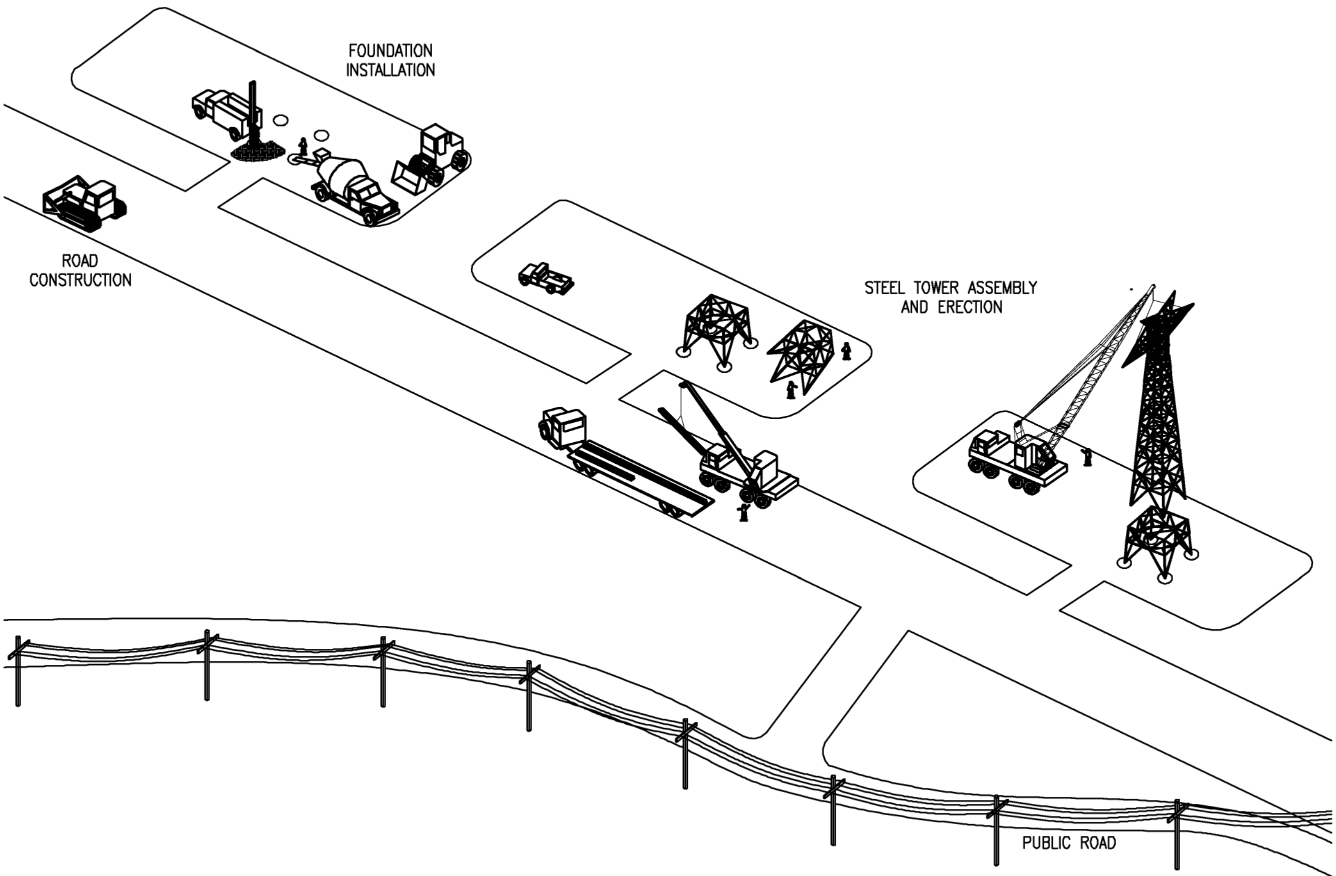
The TWE Project will require surface access to all structures and work areas during construction and operation to allow construction vehicles and equipment to access the location of each transmission structure. Access in IRAs is discussed in Section 3.5.7.3 Roadless Construction. The TWE Project has been designed to utilize existing access roads wherever practical in order to minimize environmental impacts associated with new road construction.

The construction of new access roads will be required only as necessary to access structure sites lacking direct access from existing roads, or where topographic conditions (e.g., steep terrain, rocky outcrops, and drainages) prohibit safe overland access to the site. Where terrain and soil conditions are suitable, non-graded overland access ("drive & crush") will be utilized. New access roads will be located within the ROW whenever practical and will be sited to minimize potential environmental impacts. The number of new access roads will be held to a minimum, consistent with their intended use (e.g., structure construction or conductor stringing and tensioning).

Where new roads are required, access roads will be designed in accordance with standards and guidelines set by the American Association of State Highway and Transportation Officials (AASHTO). On public lands, BLM and USFS road requirements will be followed, including standards set forth in "The Gold Book – Surface Operating Standards and Guidelines for Oil and Gas Exploration and Development" (AASHTO 2006).

As part of the COM Plan, an Access Road Plan will be developed for the Agency Preferred Alternative during final engineering and design, which will define site-specific access to each structure and temporary work area. Appendix A documents the methods used to estimate indicative access roads by terrain type for the proposed TWE Project and Alternative Route Segments. Roadless construction methods are described under Special Construction Methods, in Section 3.5.7.3.

Table 4 summarizes the access road categories used to estimate access road requirements by route segment. Figure 14 illustrates typical access road cross-sections in the various terrain conditions.



TYPICAL TRANSMISSION LINE CONSTRUCTION ACTIVITIES

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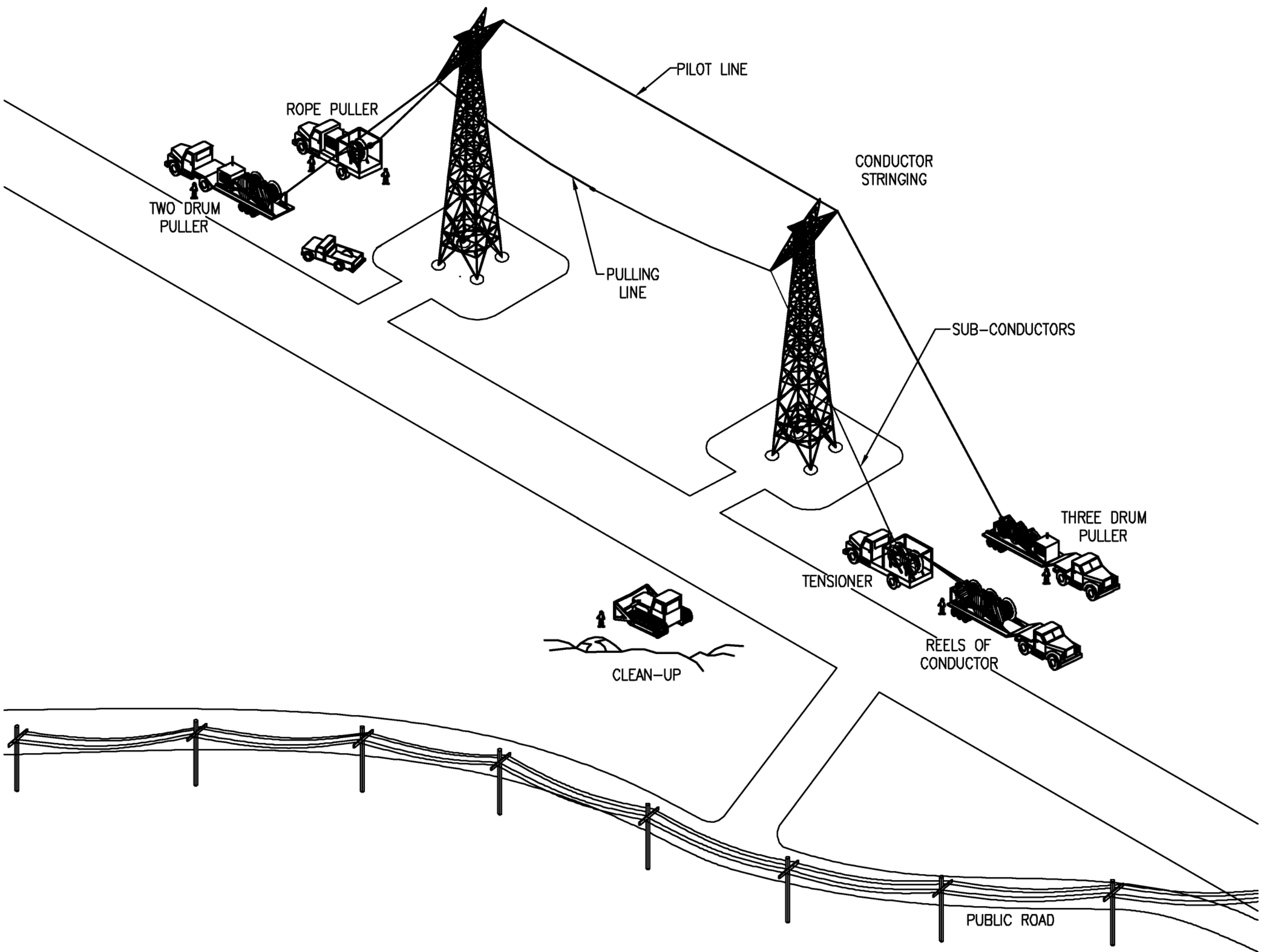
FIGURE 12
STRUCTURE FOUNDATION INSTALLATION, TOWER ASSEMBLY, & ERECTION ACTIVITIES



BASIC WIRE HANDLING EQUIPMENT
SINGLE CIRCUIT TOWER

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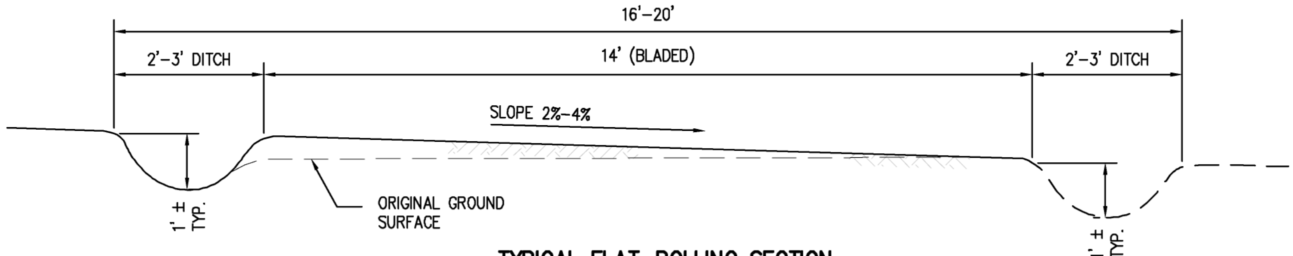
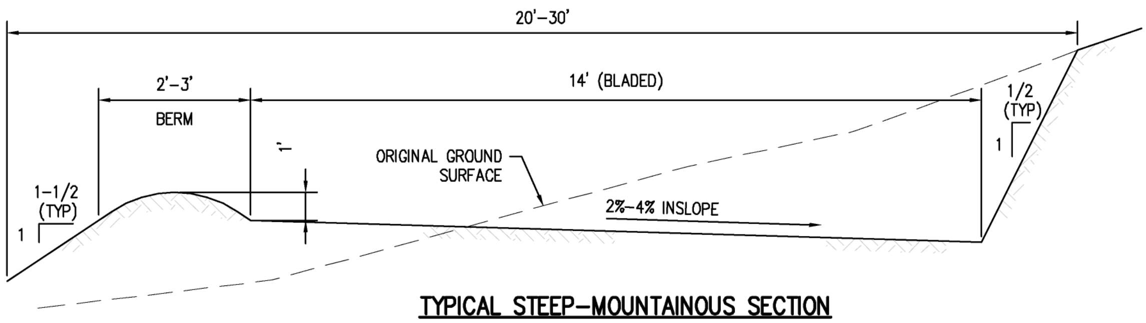
FIGURE 13
CONDUCTOR STRINGING ACTIVITIES

TABLE 4 ACCESS ROAD CATEGORIES AND DISTURBANCE ASSUMPTIONS FOR DEIS ANALYSIS		
ACCESS ROAD CATEGORY	TERRAIN TYPES	ASSUMPTION FOR ESTIMATING DISTURBANCES
Backbone Access Road Network Outside Corridors		
Category 1 – Existing Improved Roads	All terrain types	Geographic Information System (GIS) data provided. No ground disturbances would occur.
Category 2 (A) – Existing Roads Outside Corridor Requiring Improvements	All terrain types	GIS data provided. Access roads should conservatively be estimated as 24 feet wide.
Access Roads Inside Corridors		
Category 1 – Existing Improved Roads	All terrain types	GIS data provided. No ground disturbances would occur.
Category 2 (B) – Existing Roads Inside Corridor Requiring Improvements	All terrain types	For the DEIS analysis, Category 2B roads are estimated conservatively, as new roads, under Road Categories 3-6.
Category 3 – New Access Roads in Flat Terrain	Flat – 0-8% slopes	Ratio of access road miles to one mile of transmission line – 1.3 miles Access Road Width – 16 feet
Category 4 – New Access Roads in Rolling Terrain	Rolling – 8-15% slopes	Ratio of access road miles to one mile of transmission line – 1.4 miles Access Road Width – 18 feet
Category 5 – New Access Roads in Steep Terrain	Steep – 15-25% slopes	Ratio of access road miles to one mile of transmission line – 1.8 miles Access Road Width – 22 feet
Category 6 – New Access Roads in Mountainous Terrain	Mountainous – greater than 25% slopes	Ratio of access road miles to one mile of transmission line – 2.8 miles Access Road Width – 24 feet

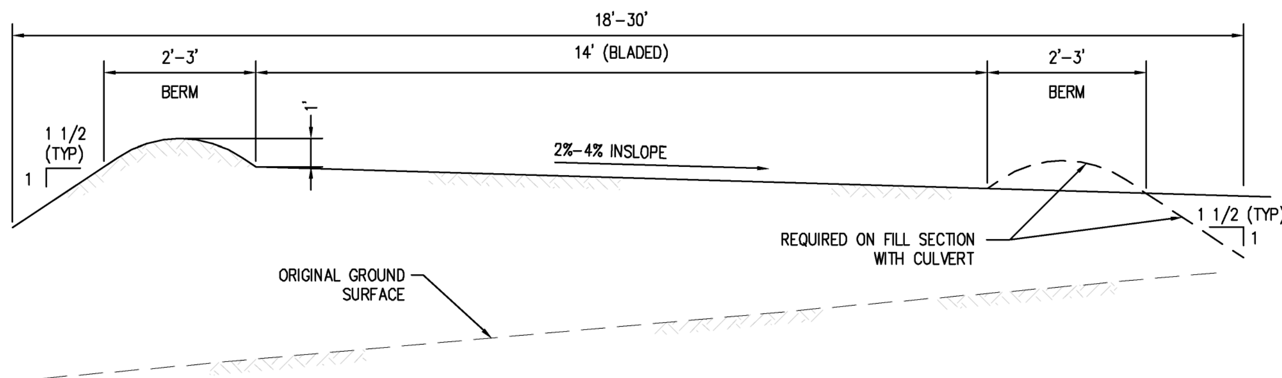
Construction of new access roads will begin with vegetation removal. Merchantable timber will be cut and stockpiled in locations where the logs can be loaded on to trucks and hauled to market. Non-merchantable logs will be stored along the edge of the ROW for later use in site restoration. Smaller vegetation will be lopped and scattered outside the road construction area. For bladed roads and where appropriate, topsoil will be removed and salvaged from the road construction area as required by the appropriate land management agency or private landowner. Topsoil will be stored adjacent to the road or in a nearby workspace. Appropriate erosion control devices will be installed to prevent erosion or loss of the topsoil, including measures to prevent wind erosion and fugitive dust, and silt fencing to prevent sediment runoff. As needed, the structure site construction pads and access roads will be bladed/graded to allow for safe access and construction. The blading/grading may include minor cut and fill as needed to achieve a safe, workable surface.



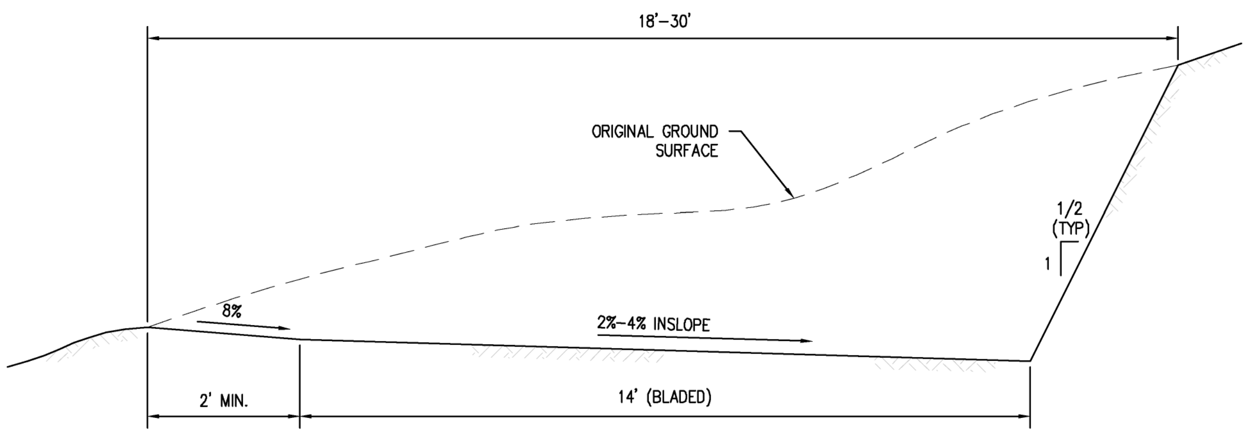
TYPICAL FLAT-ROLLING SECTION



TYPICAL STEEP-MOUNTAINOUS SECTION



TYPICAL FULL FILL SECTION



TYPICAL FULL CUT SECTION

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FIGURE 14

TYPICAL ACCESS ROAD CROSS-SECTIONS BY TERRAIN TYPE

Access road construction may employ heavy equipment including bulldozers, front-end loaders, dump trucks, backhoes, excavators - both tracked and rubber-tired, and graders. Other specialized equipment including boom trucks to install culverts in some areas will be used where needed.

3.5.2.2 Clearing of Transmission ROW and Temporary Work Areas

Vegetation within the ROW will be cleared in accordance with the TWE Project Vegetation Management Program, described in Section 3.6.2.1 and 3.6.2.2. The appropriate land management agencies and private landowners will be consulted before ROW clearing begins. Figure 15 provides a plan view of typical transmission ROW and temporary work areas.

Temporary work areas will be cleared of vegetation or flagged, as needed, prior to construction. Temporary work areas will include staging areas; material storage yards; fly yards; pulling, tensioning and spicing sites; work areas at each structure site; batch plant sites; and guard structures. Table 5 summarizes the temporary land disturbance that would be required for Project construction including the typical size and spacing required for the TWE Project facilities and activities.

TABLE 5 SUMMARY OF TEMPORARY LAND DISTURBANCE FOR WORK AREAS

TEMPORARY WORK AREA	DIMENSIONS/ SIZE	LOCATION AND NUMBER OF FREQUENCY NEEDED
TWE Project ±600 kV DC Transmission Line		
Staging Areas / Fly Yards	Average size: 7 acres	Approximately every 5 miles
Material Storage Yards	Average size: 20 acres	Approximately every 30 miles
Wire Pulling, Tensioning and Splicing Sites	ROW width x 500 feet for dead-end structure ROW width x 500 feet for mid-span conductor and shield wire 100 x 500 feet for fiber optic cable set-up sites	Two sites at every dead-end structure Approximately every 9,000 feet Approximately every 18,000 feet
Structure Work Areas	ROW width x 200 feet per structure	All structure sites, average 4 per mile
Batch Plants	Average size: 5 acres	Approximately every 15 miles
TWE Project Northern and Southern Terminals		
Storage and Concrete Batch Plant	7.5 acres	On-site
Interconnection Line structure work areas	200 feet x 200 feet (230 kV structures)* ROW width x 200 feet (500 kV structures)	All structure sites Approximately 6 per mile for 230 kV* Approximately 4 per mile for 500 kV

TABLE 5 SUMMARY OF TEMPORARY LAND DISTURBANCE FOR WORK AREAS		
TEMPORARY WORK AREA	DIMENSIONS/ SIZE	LOCATION AND NUMBER OF FREQUENCY NEEDED
Interconnection Line wire pulling, tensioning, splicing sites	ROW width x 500 feet (230 kV ROW width – 100 feet)* (500 kV ROW width – 250 feet)	Mid-span conductor and shield wire sites – every 9,000 feet Fiber optic cable set-up sites – every 18,000 feet Splicing sites typically at the same locations as the pulling/tensioning sites per common construction practices
TWE Project Northern and Southern Ground Electrode Systems		
Ground Electrode Site	65 acres	On-site
Overhead electrode line, structure work areas	ROW width x 100 feet (34.5 kV ROW width – 50 feet)	All structure sites, average 18 per mile
Overhead electrode line, pulling, tensioning, and splicing sites	75 feet x 100 feet 75 feet x 150 feet	Mid-span conductor sites – every 9,000 feet All dead-end structure sites – two sites each
Material Storage Yards	10 acres	One at each ground electrode site (total of two)
Notes: *Only applies to Northern Terminal		

The following is a summary of the purpose and use of structure work areas; wire-pulling, tensioning and splicing sites; construction staging areas/fly yards; concrete batch plants; and equipment staging and refueling sites.

Structure Work Areas

Individual structure sites will be cleared to install the transmission line structures and facilitate access for future transmission line and structure maintenance. At each structure location (±600 kV DC and 500 kV), an area up to approximately 250 by 200 feet, will be needed for construction laydown, structure assembly, and erection at each structure site. This temporary disturbance will occur within the ROW. To the extent necessary, the work area will be cleared of vegetation and bladed to create a safe working area for placing equipment, vehicles, and materials. After line construction, all areas not needed for normal transmission line maintenance, including fire and personnel safety clearance areas, will be graded to blend as near as possible with the natural contours, then revegetated as required.

Additional equipment may be required if solid rock is encountered at a structure location. Rock-hauling, hammering, or blasting may be required to remove the rock. Excess rock that is too large in size or volume to be spread at the individual structure sites will be hauled away and disposed of at approved landfills or at a location specified by the appropriate agency or landowner. See *Excavating and Installing Foundations* below for additional information on blasting activities.

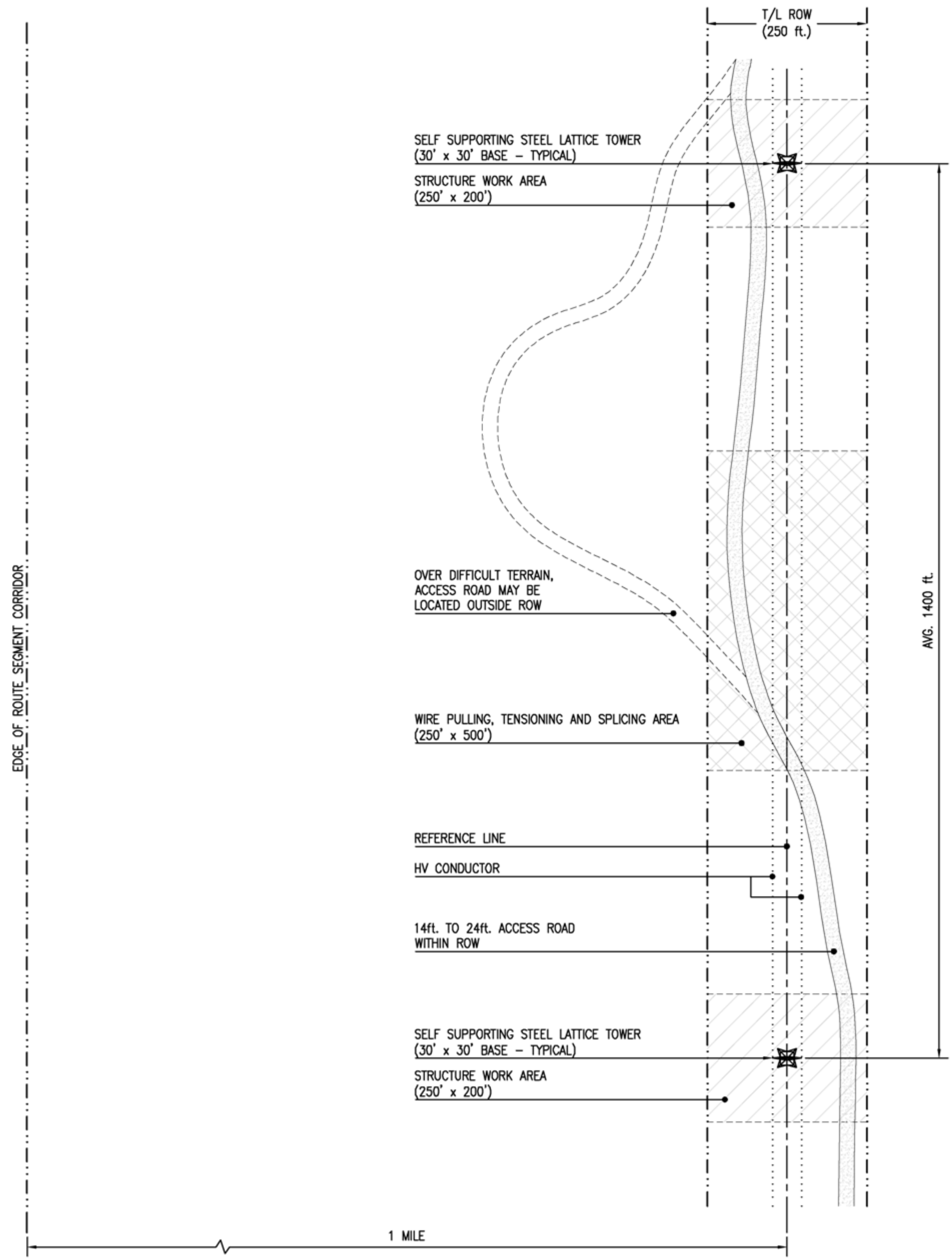

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FIGURE 15
PLAN VIEW OF TYPICAL TRANSMISSION ROW & CONSTRUCTION WORK AREAS

Wire Pulling, Tensioning, and Splicing Sites

Wire pulling, tensioning and splicing sites will be cleared and bladed only to the extent necessary to perform safe wire installation construction activities. During planning for wire installation activities wire pulling, tensioning and splicing sites will be selected to minimize clearing and blading to the extent practical such that actual disturbance areas will not exceed those described in Table 5. After line construction, all areas disturbed for wire pulling, tensioning and splicing sites will be restored as described in the COM Plan.

Construction Staging Areas/Fly Yards

The staging areas will be located in previously disturbed sites or in areas of minimal vegetative cover where possible. The staging areas will serve as field offices; reporting locations for workers; parking space for vehicles and equipment; and sites for material storage, fabrication assembly, concrete batch plants, and stations for equipment maintenance. Staging area dimensions and disturbance areas are summarized in Table 5. Additionally, fly yards for helicopter operations will be located approximately every five miles along the route where helicopter construction is planned, and will occupy approximately seven acres.

Concrete Batch Plant Sites

Concrete for use in the structure foundations will be dispensed from portable concrete batch plants located at approximately 15-mile intervals along the ROW, most located at staging areas. Sites will be identified in the COM Plan. Equipment typically required at a batch plant site includes generators, concrete trucks, front-end loaders, Bobcat loaders, dump trucks, transport trucks and trailers, water tanks, concrete storage tanks, scales, and job site trailers. Rubber-tired trucks and flatbed trailers will be used to assist in relocating the portable plant along the ROW. Commercial ready-mix concrete may be used when access to structure construction sites is economically feasible. Batch plant sites, although temporary in nature, will also be fenced.

Equipment Staging and Refueling Sites

Staging of equipment will be located at staging areas, pulling and tensioning sites, or other temporary work areas previously described. These areas will be used to temporarily lay out equipment to be used for work on specific TWE Project activities at nearby locations.

During construction, the Contractor will implement standard refueling procedures for heavy equipment that is left on the ROW for long periods of time such as cranes, blades, dozers, drill rigs, etc. This equipment will be refueled in place. As a rule, no personal or light-duty vehicles will be allowed to refuel on the ROW. Procedures and precautions similar to those used for helicopter refueling (discussed below) will be utilized.

Staging areas and helicopter fly yards will be fenced and their gates locked. Security guards will be stationed where needed. Staging area locations will be finalized following discussion with the land management agency or negotiations with landowners. In some areas, the staging area may need to be scraped by a bulldozer and a temporary layer of rock laid to provide an all-weather surface. Unless otherwise directed by the landowner, the rock will be removed from the staging area upon completion of construction and the area will be restored.

3.5.2.3 Excavation and Installation of Foundations and Anchors

The single shaft tubular steel poles and self supporting steel lattice towers will typically be supported by cast-in-place drilled concrete pier foundations. For these structure types, vertical excavations for foundations will be made with power drilling equipment. Where soils permit, truck-or track-mounted augers of various sizes, depending on the diameter and depth requirements of the hole to be drilled, will be used. Foundations for guyed steel lattice towers will typically be small precast or cast-in-place concrete pedestals. The precast pedestals will be hauled to the tower site on a flatbed truck and set in a small excavation dug by a backhoe or digger.

In rocky areas, the foundation holes may be excavated by drilling or blasting methods, or installing special rock anchor or micro-pile type foundations. The rock anchoring or micro-pile system will be used in areas where site access is limited, or adjacent structures could be damaged as a result of blasting or rock hauling activities. If hard rock is encountered within the planned drilling depth of tower foundations, blasting may be required to loosen or fracture rock. Potential areas requiring blasting will be identified based on geological setting of the proposed alignment. A Blasting Plan will be prepared as part of the COM Plan detailing the general concepts proposed to achieve the desired excavations, proposed methods for blasting warning, use of non-electrical blasting systems, provisions for controlling fly rock, vibrations, and air blast damage. Blasting is described in detail in Section 3.5.7 Special Construction Practices.

In environmentally sensitive areas with very soft soils, a HydroVac, which uses water pressure and a vacuum, may be used to excavate material into a storage tank. Alternatively, a temporary casing may be used during drilling to hold the excavation open, and then the casing is withdrawn as the concrete is placed in the hole. In areas where it is not possible to operate large drilling equipment due to access or environmental constraints, hand-digging may be required.

In areas where single shaft tubular steel pole structures are used, increased volumes of excavated subsoil spoils, based on foundation size and depth may require spreading beyond the general disturbance area to maintain grades and runoff, and to facilitate restoration. In these areas, topsoil will be salvaged and set aside to be placed over the subsoil material during restoration. These locations will be mitigated on a case-by-case basis. Spoil material will be used for backfill where suitable, and the remainder will be spread at the tower site or along graded access roads or in locations previously agreed upon by the Applicant and the appropriate land management agency or private landowner.

Foundation or anchor holes left open or unguarded will be covered to protect the public and wildlife. If practical, fencing may be used. All safeguards associated with using explosives (e.g., blasting mats) will be employed. Blasting activities will be coordinated with the appropriate agencies, particularly for purposes of safety and protection of sensitive areas and biological resources. In extremely sandy areas, water or an appropriate land management agencies' approved gelling agent will be used to stabilize the soil before and during excavation.

Reinforced-steel anchor bolt cages will be installed after excavation and prior to structure installation. These cages are designed to increase the structural integrity of the foundations, will be assembled at the nearest laydown yard or staging area, and delivered to the tower site via flatbed truck. These cages will be inserted in the holes prior to pouring concrete. The excavated holes containing the reinforcing anchor bolt cages will be filled with concrete.

Typically, and because of the remote location of much of the transmission line route, concrete will be provided from portable batch plant areas as described above. Concrete will be delivered directly to the site in concrete trucks with a capacity of up to ten cubic yards. In the more developed areas along the route, the Contractor may use local concrete providers to deliver concrete to the site when economically feasible.

Guyed lattice structures require the installation of anchors and guy wires to support the structure. Depending upon the soil type and engineering strength requirements, anchors will be either excavated plate anchors, drilled and epoxy, or grouted anchors.

Drilled anchors will require a small truck or track mounted drilling equipment that will drill a hole four to eight inches in diameter, 20 to 40 feet or more in depth. The anchor rod is inserted into the open bore and secured to the soil or rock either with epoxy or grout.

Plate anchor are installed in a three to four foot diameter excavation, 10 to 20 feet in depth, drilled by a small truck or track mounted drilling rig. The anchor rod is attached to the plate anchor, placed in the hole and the excavation is backfilled and compacted.

3.5.2.4 Erection of Transmission Structures

Bundles of steel members and associated hardware (insulators, hardware, and stringing sheaves) will be transported to each structure site by truck. Wood blocking will be hauled to each location and laid out; the tower steel bundles will be opened and laid out for assembly by sections and assembled into subsections of convenient size and weight. Typically, the leg extensions for the towers will be assembled and erected by separate crews with smaller cranes to make ready for setting of the main tower assembly. The assembled subsections will then be hoisted into place by means of a large crane and fastened together to form a complete tower. A follow-up crew then will tighten all the bolts in the required joints. Refer to Figure 12 for a general illustration of this procedure. The use of helicopters for structure erection is described in Section 3.5.7 Special Construction Practices.

3.5.2.5 Stringing of Conductors, Shield Wire, and Fiber Optic Ground Wire

Insulators, hardware, and stringing sheaves will be delivered to each tower site. The towers will be rigged with insulator strings and stringing sheaves at each shield (ground) wire and conductor position.

Interruption of road traffic on all types of roads (county, state, federal, interstate) is not anticipated during conductor stringing and tensioning activities unless required under the terms and conditions of a specific road or highway crossing permit. As described below, pilot lines will be pulled from tower to tower by either a helicopter (most commonly) or land operated equipment. The use of a helicopter to pull the pilot lines is commonly used so that impacts to road traffic are minimized or avoided. For safety and efficiency reasons, wire stringing and tensioning activities are typically performed during daylight hours and are scheduled to coincide to the extent practical with periods of least road traffic in order to minimize traffic disruptions.

Railroad crossing operations and procedures are controlled by and permitted through the railroad company operating the affected rail line (see the Union Pacific Railroad website for Overhead Wire Crossings as an example). Terms and conditions to be followed are specified in the crossing permit. Typically, stoppage of railroad traffic is not required during construction or conductor stringing and tensioning activities. Crossing activities are similar to those for road crossings and typically involve the use of guard structures as discussed below. Stringing and tensioning activities will be performed in coordination with the appropriate railroad authorities. For safety and efficiency, stringing and tensioning activities are performed during daylight periods and scheduled to coincide with times of least railroad traffic. The railroad will typically provide a switchman who is present at all times when work is being performed near or over any railroad line.

For protection of the public during stringing activities, temporary guard structures will be erected at road crossing locations where necessary. Guard structures will consist of H-frame wood poles placed on either side of the road to prevent ground wires, conductors, or equipment from falling on underlying facilities and disrupting road traffic. Typically, guard structures are installed just outside of the road ROW. Although the preference is for access to each of these guard structures to be located outside the road ROW, it may be necessary for access to be within the road ROW depending on topography and access restrictions imposed by the regulatory agency (i.e., State Department of Transportation (DOT), county road and bridge department, etc.). Access use within the road ROW will be performed in compliance with the stipulations of the crossing permit and regulatory agency requirements.

Site specific road crossing locations with excessive widths (generally greater than 200 to 300 feet) such as may occur on interstate highways would require installation of temporary guard structures in medians between opposite traffic flow lanes. Although TransWest does not currently anticipate needing guard structures in medians, as final engineering design progresses, locations requiring center median guard structures may be identified. The erection and dismantling of these temporary guard structures may require short-term traffic diversions. These short-term traffic diversions, which may last from a few hours to a day, are most commonly a short duration closure of the shoulder of the road or in more congested locations might consist of the closure of one lane of traffic. Complete closure of one direction of traffic is not anticipated. Temporary traffic diversion signs, signals, markers, barriers and traffic control personnel, if required by the State DOT, will be employed. These activities would be coordinated with the appropriate State DOTs. Traffic disruptions will be kept to a minimum and TransWest will comply with crossing permit requirements which typically limit durations of traffic interruptions.

In urban locations or for extremely high volume roadways (such as interstate highways), the State DOTs may require the installation of protective steel netting above the roadway for the duration of wire stringing and tensioning operations (generally ranging from a few days to two to three weeks). The installation of protective steel netting requires a brief closure of the roadway (generally 3 - 20 minutes) while the netting is pulled across the roadway and hoisted onto the temporary support structures. This process is repeated when the netting is removed. Because of the heavy traffic volume and the impact of stopping traffic, netting is typically installed during the lowest traffic period (normally 3am to 5am on a Sunday morning) per the requirements of the State DOT. Although not anticipated, any road stoppage will employ all appropriate State DOT traffic safety requirements (signage, flagmen, lighting, signals, temporary barriers, law enforcement, etc.).

The delivery of large pieces of equipment or material as part of the construction process may slow or interrupt traffic on state or county roads on a short-term basis. The duration of these types of traffic disruption are typically very short, a few minutes or less while the delivery truck passes down a roadway or turns a corner. The limited number of large pieces of equipment or material that are delivered to any one portion of the project tends to make traffic disruptions infrequent and generally unnoticed by the motoring public.

Equipment for erecting guard structures will include augers, backhoes, line trucks, boom trucks, pole trailers, and cranes. Guard structures may not be required for small roads. In such cases, other safety measures such as barriers, flagmen, or other traffic controls will be used. Following stringing and tensioning of all ground wires and conductors, the guard structures will be removed and the area restored.

Pilot lines will be pulled (strung) from tower to tower by either a helicopter or land operated equipment, and threaded through the stringing sheaves at each tower. Following pilot lines, a stronger, larger diameter line will be attached to conductors to pull them onto towers. This process will be repeated until the shield wire, optical ground wire, or conductor is pulled through all sheaves.

Shield wires, fiber optic cable, and conductors will be strung using powered pulling equipment at one end and powered braking or tensioning equipment at the other end of a conductor segment. Site dimensions for pulling and tensioning equipment are provided in Table 5. These sites may differ in size and dimensions, however, depending on the structure's purpose (e.g., mid-span or dead-end), site-specific topography, and whether anchoring of the shield wire or conductor will be located at these sites. The tensioner, in concert with the puller, will maintain tension on the ground wires or conductor while they are fastened to the towers. Once each type of wire has been pulled in, the tension and sag will be adjusted, stringing sheaves will be removed, and the conductors will be permanently attached to the insulators.

Tension will be maintained on all insulator assemblies to ensure positive contact between insulators, thereby avoiding sparking. Caution also will be exercised during construction to avoid scratching or nicking the conductor surface, which may provide points for corona to occur. Refer to Figure 13 for a general illustration of this procedure.

At tangent and small-angle towers, the conductors will be attached to the insulators using clamps while at the larger angle dead-end structures the conductors are cut and attached to the insulator assemblies by "dead-ending" the conductors, either with a compression fitting or an implosive type fitting. Both are industry-recognized methods. When utilizing the implosive type fitting, pertinent land management agencies, private landowners, and public safety organizations will be notified before proceeding with this method.

Part of standard construction practices prior to conductor installation will involve measuring the resistance of the ground to electrical current near the towers. If the measurements indicate a high resistance, counterpoise will be installed, which will consist of trenching in-ground wire to a depth of 12 inches in non-cultivated land and 18 inches in cultivated land, with a ground rod driven at the end. The counterpoise will be contained within the limits of the ROW and may be altered or doubled back and forth to meet the requirements of the TWE Project. Typical equipment used for installing ground rods includes line trucks, backhoes, and trenchers.

3.5.2.6 Clean-up and Site Reclamation

Construction sites, material storage yards, and access roads will be kept in an orderly condition throughout the construction period. Refuse and trash will be removed from the sites and disposed of in an approved manner (e.g., in an approved landfill). In remote areas, trash and refuse will be removed to a construction staging area and contained temporarily until such time as it can be hauled to an approved site. No open burning of construction trash will occur. Contaminants such as oils, hydraulic fluids, antifreeze, and fuels will not be dumped on the ground, and all spills will be cleaned up. A Hazardous Materials Management Plan will be prepared with the COM Plan.

For permanent access roads, the primary road surface will remain and not be restored to original contours so that a stable road will be present if equipment is needed to access a tower during operation and maintenance. Construction roads and trails not required for maintenance will be restored to the original contour, seeded, and be left in a condition acceptable to the land management agency or private landowner. The surfaces of these construction roads and trails will be scarified as needed to provide conditions that will facilitate natural revegetation, provide for proper drainage, and prevent erosion (Western 2010).

Following construction, where reasonable, in the areas where it has been determined the access roads will be temporary, the topsoil may be bladed back across the disturbed road section and the access blocked as determined through mutual agreement by the Applicant and the appropriate land management agency or private landowner. In these areas, seeds and roots contained within the respread topsoil layer normally provide a natural source for new growth. A ROW Preparation, Rehabilitation, and Restoration Plan will be developed.

Disturbed areas not required for access roads and maintenance areas around structures will be restored and revegetated, as required by the appropriate land management agency or private landowner. Temporary access roads will be decompacted and the topsoil replaced. The land-management agency, private landowner or local National Resource Conservation Service (NRCS) office will be consulted regarding the appropriate seed mix and rate to revegetate the road surface. Vegetation on an eight-foot wide road surface may be periodically managed to allow equipment travel if necessary. Temporary culverts will be removed. Drivable at-grade waterbars will be installed where needed with frequency proportional to road slope to prevent erosion of the roadbed. Applicable agency Best Management Practices (BMPs) will be implemented. All practical means will be made to restore the land outside the minimum areas needed for safe operation and maintenance to its original contour and to restore natural drainage patterns along the ROW.

3.5.3 Terminal and Substation Construction

Terminal construction activities will occur at the Northern and Southern Terminals. Section 3.5.9.3 summarizes the types of construction equipment to be used at each terminal, substation or series compensation station.[10]

Construction of the AC/DC converter stations, substations or series compensation stations will initially consist of survey work, geotechnical sample drillings approximately 20 to 50 feet deep, and soil resistivity measurements that will be used in the final design phases of the station. Once the final design of the station has been completed, a Contractor will mobilize to perform site development

[10] Terminal construction for the proposed Project includes the adjacent substations. Separate substations and/or series compensation stations are required for System Alternatives 2 and 3. Descriptions of the construction for the substations and series compensation station for System Alternatives 2 and 3 are included within this section for convenience and completeness.

work, including grubbing and then reshaping the general grade to form a relatively (one percent slope) flat working surface. This effort also will include the construction of permanent all-weather access roads. An eight-foot-tall chain link fence will be erected around the perimeter of the terminal, substation or series compensation station to prevent unauthorized personnel from accessing the construction and staging areas. The perimeter fence will be a permanent feature to protect the public from accessing the facility. The excavated and fill areas will be compacted to the required densities to allow structural foundation installations. Oil containment structures required to prevent oil from transformers, reactors, circuit breakers, etc., from getting into the ground or water bodies in the event of rupture or leak, will be installed.

Following the foundation installation, underground electrical raceways and copper ground grid installation will take place, followed by steel structure erection and area lighting. The steel structure erection will overlap with the installation of the insulators and bus bar, as well as the installation of the various high-voltage apparatus typical of an electrical substation. The converter valve hall and ancillary buildings will be erected. The installation of the high-voltage transformers will require special high-capacity cranes and crews (as recommended by the manufacturer) to be mobilized for the unloading, setting into place, and final assembly of the transformers. While the above mentioned activities are taking place, the enclosures that contains the control and protection equipment for the terminal, substation and series compensation station will be constructed, equipped, and wired. A final crushed rock surface will be placed on the subgrade to make for a stable driving and access platform for the maintenance of the equipment. After the equipment has been installed, testing of the various systems will take place, followed by electrical energization of the facility. The energization of the facility generally is timed to take place with the completion of the transmission line work and other required facilities.

Soil Boring

Typically, soil borings will be made on a 600-foot grid spacing within the terminal, substation or series compensation station, particularly at the approximate location of large structures and equipment such as substation dead-ends and transformers, to determine the engineering properties of the soil for foundation design. Borings will be made with truck- or track-mounted equipment. The borings will be approximately four inches in diameter, range from 20 to 50 feet deep, and be backfilled with the excavated material upon completion of soil sampling.

Clearing and Grading

The Contractor will mobilize to perform site development work including grubbing, grading and construction of an all-weather access road (gravel). Clearing of all vegetation will be required for the entire terminal, substation or series compensation station area, including a distance of approximately eight to ten feet outside the fence.

Once the vegetation is cleared, the entire site will be graded essentially flat, with enough slope to provide for runoff of precipitation. The site will be graded to use existing drainage patterns to the extent possible. Depending upon the size of the site a more complex drainage design may be required to handle larger volumes of runoff. Drainage design for large sites may require drainage zones, retention basins, and drainage structures such as ditches or culverts. After grading, the entire site will be treated with a soil sterilizer to prevent vegetation growth to minimize future maintenance. Clearing and grading material will be disposed of in compliance with local ordinances. Material from off-site will be obtained at existing borrow or commercial sites and will be trucked to the site using existing roads and the site access road.

Once installation of foundations, underground electrical raceways and copper ground grid are completed, a four to six inch layer of crushed rock will be applied to the finished surface of the station to provide a solid all-weather working surface and to protect personnel from high currents and voltages during electrical fault conditions.

Storage and Staging Yards

Construction material storage yards may be located outside the terminal, substation or series compensation station-fenced area near the facility being constructed. These storage yards may be part of the terminal, substation series compensation station property or leased by the Contractor. After construction is completed, all debris and unused materials will be removed and the staging/storage yards returned to preconstruction conditions by the Contractor.

Grounding

A grounding system will be required in each terminal, substation and series compensation station for detection of faults and for personnel safety. The grounding system typically consists of buried copper conductor arranged in a grid and driven ground rods, typically eight to ten feet long. The ground rods and any equipment and structures are connected to the grounding conductor. The amount of conductor and length and number of ground rods required will be calculated based on fault current and soil characteristics.

Fencing and Lighting

Security fencing will be installed around the entire perimeter of each terminal, substation and series compensation station to protect sensitive equipment and prevent accidental contact with energized conductors by third parties. This seven-foot-high fence would be constructed of chain link with steel posts. One foot of barbed wire or similar material will be installed on top of the chain link yielding a total fence height of eight feet. Locked gates will be installed at appropriate locations for authorized vehicle and personnel access.

Safety and security lighting at the terminals, substations and series compensation stations will be provided inside the fence for safety and security, and for uncommon emergency night repair work. Dusk to dawn safety and security lighting will be used at the terminals and 500 kV AC substations.

Foundation Installation

Foundations for supporting structures and large buildings are of two types: spread footings or drilled piers. Spread footings are placed by excavating the foundation area, placing forms and reinforced-steel and anchor bolts, and pouring concrete into the forms. After the foundation has been poured, the forms would be removed, and the surface of the foundation finished. Drilled pier foundations are placed in a hole generally made by a track or truck-mounted auger. Reinforced-steel and anchor bolts are placed into the hole using a track or truck-mounted crane. The portion of the foundation above ground would be formed. The portion below ground uses the undisturbed earth of the augured hole as the form. After the foundation has been poured, the forms would be removed, the excavation would be backfilled, and the surface of the foundation finished.

Equipment foundations for circuit breakers, transformers, and small prefabricated buildings will be slab-on-grade type. These foundations are placed by excavating the foundation area; placing forms, reinforced steel, and anchor bolts (if required); and placing concrete into the forms. After the foundations have been poured, the forms are removed, and the surface of the foundation finished. Where necessary, provisions will be made in the design of the foundations to mitigate potential problems due to frost. Reinforced steel and anchor bolts will be transported to each site by truck, either as a prefabricated cage or loose pieces, which will then be fabricated into cages on the site. Concrete will be hauled to the site in concrete trucks. Excavated material will be spread at the site or disposed of in accordance with agency requirements or local ordinances. Structures and equipment will be attached to the foundations by means of threaded anchor bolts embedded in the concrete. Some equipment such as transformers and reactors may not require anchor bolts.

Oil Containment

Some types of electrical equipment, such as transformers, and some types of reactors and circuit breakers, are filled with an insulating mineral oil. Containment structures are required to prevent equipment oil from getting into the ground or waterbodies in the event of a rupture or leak. These structures take many forms depending on site requirements, environmental conditions, and regulatory restrictions. The simplest type of oil containment is a pit, of a calculated capacity, under the oil-filled equipment that has an oil-impervious liner. The pit is filled with rock to grade level. In case of an oil leak or rupture, the oil captured in the containment pit is pumped into tanks or barrels and transported to a disposal facility. If required, more elaborate oil-containment systems can be installed. This may take the form of an on-site or off-site storage tank and/or oil-water separator equipment depending on site requirements.

Structure and Equipment Installation

Supporting steel structures are erected on concrete foundations. These are set with a track or truck-mounted crane and attached to the foundation anchor bolts by means of a steel base plate. These structures will be used to support the energized conductors and certain types of equipment. This equipment will be lifted onto the structure by means of a truck-mounted crane and bolted to the structures; electrical connections are then made. Some equipment, such as transformers, reactors, and circuit breakers, will be mounted directly to the foundations without supporting structures. These will be set in place by means of a truck-mounted crane. Some of this equipment requires assembly and testing on the pad. Electrical connections to the equipment will then be made.

Equipment Housing, Control, Storage and Ancillary Building Construction

The Project will require several buildings at each terminal, substation or series compensation site. Depending upon size and function, these buildings will be either prefabricated or constructed on site as concrete block or metal clad steel frame buildings.

The following provides a brief description and approximate dimension of the building types generally required for the terminals:

> The **HVDC Converter Valve Hall** is a large building that contains the high-voltage electronics involved in the conversion process (referred to as valves), the valve cooling circulation system (pipes required to circulate the cooling medium), clean air exchange, and other supporting environmental conditions required for operation of the converter system. The valves are typically suspended from the ceiling of the building which requires large

clearance distances to the ground and surrounding structures due to the high voltages that are generated within the building during the conversion process. The building will be approximately 60 to 80 feet in height and the footprint will be approximately 200 by 80 feet. There will be two buildings of this size; one housing the valve equipment for the positive DC pole and the other housing the equipment for the negative DC pole.

An **HVDC Auxiliary Support Building** is typically placed between the two valve halls or very near the valve halls. This building contains the pumps and heat exchange system for cooling of the valves. The building is typically 100 feet wide, 100 feet long and approximately 20 feet high.

A **Main Operations Building** housing operations, general office and support functions is approximately 150 by 150 feet square and is typically a two-story building with a complete basement. The HVDC control room and supporting control systems are housed in a main operations building. The telecommunications equipment, the HVDC controls equipment, and the operational control room are typically located in separated secure spaces to assure safety and to restrict access to all levels of automation and telecommunication. Operations, administrative staff, and maintenance dispatch supporting facilities are also located within this building. Control spaces will be equipped with full ranges of uninterrupted power supply power protection, fire safety operations, and dispatcher coordination centers. This facility will also include the SCADA control and monitoring systems for the Project's entire AC substation, and transmission systems as necessary up to the points of interconnection with the regional grid.

The **Security Control Office Building** will be an approximately 30 by 30 foot single story building with a full basement, to facilitate life safety and other equipment including domicile facilities for security personnel on extended shift work.

The **Diesel Generator Building** will be an approximately 100 by 30 foot single story building. This building contains diesel generators and support equipment necessary to operate the facility on loss of the primary power source.

The **DC Switchyard Building** is typically a single story building of approximately 30 feet by 60 feet. One or more control buildings may be required at each terminal to house control devices, battery banks for primary control power, and remote monitoring equipment. The size and construction of the building will depend on DC switchyard requirements. Typically, the control building will be constructed of concrete block, pre-engineered metal sheathed, or composite surfaced materials. Once the control house is erected, protection and control equipment will be mounted and wired inside.

A **Hazardous Chemical and Dry Storage Building** will be developed to place the various chemical bulk storage and other items outside and apart from the other buildings in the terminal complex. This building will be approximately 30 feet by 30 feet. This building will be supplied with the code required containment, life, and fire safety systems.

A **Dry Indoor Storage Building** will be developed based on the requirements of the HVDC Contractor and is estimated to be approximately 100 feet by 150 feet, single story, high bay building.

The following provides a brief description and approximate dimension of the buildings types generally required for the terminals, substations and series compensation stations:

> The **AC Switchyard Control House** is typically a single story structure of approximately 30 feet by 60 feet. One or more control buildings may be required at each switchyard, substation or series compensation station to house protective relays, control devices, battery banks for primary control power, and remote monitoring equipment. The size and construction of the building will depend on individual substation requirements. Typically, the control building will be constructed of concrete block, pre-engineered metal sheathed, or composite surfaced materials. Once the control house is erected, protection and control equipment will be mounted and wired inside.

Conductor Installation

The two main types of high-voltage conductors used in terminals and substations are tubular aluminum for rigid bus sections and/or stranded aluminum conductor for strain bus and connections to equipment. Rigid bus will be a minimum of four inches in diameter and will be supported on porcelain or polymer insulators on steel supports. The bus sections will be welded together and attached to special fittings for connection to equipment. Stranded aluminum conductors will be used as flexible connectors between the rigid bus and the station equipment.

Conduit and Control Cable Installation

Most terminal and substation equipment requires low-voltage connections to protect relaying and control circuits. These circuits allow metering, protective functions, and control (both remote and local) of the power system. Connections will be made from the control building to the equipment through multi-conductor control cables installed in conduits and/or a pre-cast concrete cable trench system.

3.5.4 Ground Electrode Construction

Construction of the two ground electrode facilities will be initiated with a survey and staking to layout the location of the access road, deep earth electrode wells, control building and low voltage underground electrical, control and monitoring cables connecting the wells to the control building. The Contractor will mobilize to perform site development work including grubbing and grading and construction of an all-weather access road (gravel). Grubbing, grading, and contouring of the entire site is not required. Removal of vegetation will be required for the access road, control building site, well sites, alignments of the underground electrical, control and monitoring cables and on-site material storage yard/staging area.

Once the vegetation is cleared, the control building site will be graded essentially flat, with enough slope to provide for runoff of precipitation. After grading, the control building site will be treated with a soil sterilizer to prevent vegetation growth to minimize future maintenance. Next, a thin layer of gravel or crushed rock will be applied to the finished surface of the control building site. With the exception of the permanent and temporary access roads, no additional grading will be required. Clearing and grading material will be disposed of in compliance with local ordinances. Material from off-site will be obtained at existing borrow or commercial sites, and will be trucked to the regeneration site using existing roads and the regeneration site access road.

Security fencing will be installed around the perimeter of the control building site. This seven-foot-high fence would be constructed of chain link with steel posts. One foot of barbed wire or similar material will be installed on top of the chain link yielding a total fence height of eight feet. A locked gate will be installed for authorized vehicle and personnel access.

Foundations for the prefabricated building will be slab-on-grade type. These foundations are placed by excavating the foundation area; placing forms, reinforced steel, and anchor bolts; and placing concrete into the forms. After the foundations have been poured, the forms are removed, and the surface of the foundation finished. Where necessary, provisions will be made in the design of the foundations to mitigate potential problems due to frost.

Reinforced steel and anchor bolts will be transported to each site by truck which will then be fabricated into cages on the site. Concrete will be hauled to the site in concrete trucks. Excavated material will be spread at the site or disposed of in accordance with agency requirements or local ordinances. The pre-fabricated building will be transported to the site by truck and attached to the foundations by means of threaded anchor bolts embedded in the concrete.

Each ground electrode site will require drilling approximately 60 deep earth wells. Each electrode well will be a 12 to 18 inch diameter bore drilled to a depth of 200 to 700 feet (depth based upon engineering and design). The well drilling will require small amounts of water which will be procured from commercial or municipal sources. Ground water will not be removed although small amounts of water, mud and spoil will be brought to the surface as part of the drilling process. All excess water, mud, drilling fluids, and spoils will be contained adjacent to the drill rig and when completed will be disposed of per landowner and agency requirements.

Once drilling is completed, a wire will be grouted into the well, the well capped, and a small area excavated around the well head for the installation of the utility access vault. A precast concrete utility access vault is installed. This utility access vault provides access to the well in addition to preventing public access to the well connections or electrode components.

Several underground cables are installed in trench connecting each well to the control building. These cables provide a low voltage electrical connection from the control building to each well, and perform control and monitoring functions. Cables will be direct buried with the trench backfilled and compacted with spoil. Once backfilling is complete, the trenched area will be contoured back to match existing slopes and grades.

A communication system used for monitoring and control of the ground electrode facility will be installed. This communication link will require installation of either a buried or overhead fiber optic cable, and equipment or fixed radio communication equipment and antenna.

Connection to a local electric distribution circuit will be required to provide power to the site. Additionally, an emergency generator with a liquid propane (LP) gas fuel tank will be installed adjacent to the control building inside the fenced area.

3.5.5 Communications System Construction

The fiber optic network will require regeneration sites at periodic distances along the transmission line, as determined in the detailed engineering studies. In general, these regeneration sites are planned to be within the transmission line ROW. The communications system facilities will be constructed concurrently with the transmission line.

Construction will be initiated with a survey and staking to layout the location, and extent of the regeneration site. The Contractor will mobilize to perform site development work including grubbing, grading, and construction of an all-weather access road (gravel).

Clearing of all vegetation will be required for the entire regeneration site, including a distance of approximately eight to ten feet outside the fence. Once the vegetation is cleared, the entire regeneration site will be graded essentially flat, with enough slope to provide for runoff of precipitation. After grading, the entire site will be treated with a soil sterilizer to prevent vegetation growth to minimize future maintenance. Next, a thin layer of gravel or crushed rock will be applied to the finished surface of the regeneration site. Clearing and grading material will be disposed of in compliance with local ordinances. Material from off-site will be obtained at existing borrow or commercial sites, and will be trucked to the regeneration site using existing roads and the regeneration site access road.

Security fencing will be installed around the entire perimeter of each regeneration station. This seven-foot-high fence would be constructed of chain link with steel posts. One foot of barbed wire or similar material will be installed on top of the chain link yielding a total fence height of eight feet. A locked gate will be installed for authorized vehicle and personnel access.

Foundations for the prefabricated building(s) will be slab-on-grade type. These foundations are placed by excavating the foundation area; placing forms, reinforced steel, and anchor bolts; and placing concrete into the forms. After the foundations have been poured, the forms are removed, and the surface of the foundation finished. Where necessary, provision will be made in the design of the foundations to mitigate potential problems due to frost.

Reinforced steel and anchor bolts will be transported to each site by truck which will then be fabricated into cages on the site. Concrete will be hauled to the site in concrete trucks. Excavated material will be spread at the site or disposed of in accordance with agency requirements or local ordinances. Pre-fabricated building(s) will be transported to the site by truck and attached to the foundations by means of threaded anchor bolts embedded in the concrete.

The fiber optic cable will be connected from the splice box located near the bottom of the nearest transmission structure to the control building at the regeneration site via two diverse paths, either overhead or underground. The overhead path may require one, two or three short distribution type poles all located on the transmission ROW. An underground path will require trenching and burial of an underground fiber optic cable. All trenching is to occur on the transmission ROW.

Connection to a local electric distribution circuit will be required to provide power to the site. Additionally, an emergency generator with a LP gas fuel tank will be installed at the site inside the fenced area.

A short tower (generally less than 30 feet) with a UHF/VHF radio antenna will be installed to provide communication support for transmission line patrol and maintenance operations and allow emergency operations independent of commercial common carrier (i.e., cellular telephone).

3.5.6 Post Construction Clean-Up and Restoration

Terminal, ground electrode, series compensation station and transmission line construction will generate a variety of solid wastes including concrete, hardware, and wood debris. The solid wastes generated during construction will be recycled or hauled away for disposal. Excavation along the ROW and at terminals and substations will generate excavated subsoil spoil that could potentially be used as fill; however, some of the excavated material will be removed for disposal.

The majority of waste associated with terminal and substation construction results from spoils created during site grading. Very little of the soil excavated during foundation installation is waste product. Above-grade waste will be packing material such as crates, pallets, and paper wrapping to protect equipment during shipping. It is assumed a 12-yard dumpster will be filled once a week with waste material for the duration of each terminal or substation project.

Clean-up and restoration will consist of:

- Removing packing crate reels, shipping material and debris, and disposing of them at approved landfill sites;
- Backfilling holes and ruts in access roads, installing water bars, and doing final grading;
- Dressing work sites and structure sites to remove ruts;
- Mitigating soil compaction and leveling, disking, and preparing areas for seeding, as required;
- Maintaining permanent access roads as needed for future maintenance work;
- Leaving access roads in place, but not regularly maintaining them. Access roads will be graded, have water bars installed, and reseeded to encourage vegetation cover according to appropriate land management agency or private landowner requirements;
- Repairing fences and gates to their original condition or better;
- Grounding fences;
- Seeding and revegetating, as specified in the COM Plan and in accordance with appropriate land management agency or private landowner requirements; and
- Contacting property owners and processing claims for settlement.

3.5.7 Special Construction Practices

3.5.7.1 Blasting

As described earlier in this section, foundations for tubular steel poles and self supporting steel lattice towers will normally be installed using drilled shafts or piers. Foundations for guyed steel lattice towers will typically be small precast or cast-in-place concrete pedestals. If hard rock is encountered within the planned drilling depth, blasting may be required to loosen or fracture the rock to reach the required depth to install the tower foundations. Areas where blasting will likely occur will be identified during final design based on the geologic conditions of the Agency Preferred Alternative alignment as determined by the geotechnical investigation. The Contractor will be required to prepare a Blasting Plan for the Project, subject to the approval of the Applicant. The Blasting Plan will detail the Contractor's proposals for compliance with the Applicant's blasting specifications and Blasting Plan framework from the COM Plan, and will detail the general concepts proposed to achieve the desired excavations. In addition, the Plan will address proposed methods for controlling fly rock, for blasting warnings, and for use of non-electrical blasting systems. The Contractor will be required to provide data to support the adequacy of the proposed efforts regarding the safety of structures and slopes and to ensure that an adequate foundation is obtained. When utilized, blasting will take place between sunrise and sunset.

The Blasting Plan will contain shot plans which will detail the drilling and blasting procedures; the number, location, diameter, and inclination of drill holes; the amount, type, and distribution of explosive per hole and delay; and pounds of explosive per square foot for pre-splitting and smooth blasting. The Contractor will be required to maintain explosives logs.

Blasting near buildings, structures, and other facilities susceptible to vibration or air blast damage will be carefully planned by the Contractor and the Applicant, and controlled to eliminate the possibility of damage to such facilities and structures. The Blasting Plan will include provisions for control to eliminate vibration, fly rock, and air blast damage.

Blasting will be very brief in duration (milliseconds), and the noise will dissipate with distance. Blasting produces less noise and vibration than comparable non-blasting methods to remove hard rock. Non-blasting methods include track rig drills, rock breakers, jack hammers, rotary percussion drills, core barrels, and rotary rock drills with rock bits, which all require much longer time duration to excavate the same amount of rock as blasting.

3.5.7.2 Helicopter Construction

Helicopter construction techniques may be used for the erection of structures, stringing of conductor and shield wire, and other Project construction activities. The use of helicopters for structure erection is evaluated based on site- and region-specific considerations including access to structure locations, sensitive resources, permitting restrictions, construction schedule, weight of structural components, time of year, elevation, availability of heavy lift helicopters, and/or construction economics.

Helicopter erection of structures is a viable option for all locations without restrictions prohibiting or restricting helicopter use. As such "fly yards", each seven acres in size have been incorporated into Project planning. In areas without restrictions on helicopter usage, the decision to employ helicopter construction techniques will be determined by the Contractor. However it is not anticipated that helicopter erection will be used except potentially in areas with extremely difficult access, in areas with some form of access restriction or in areas required by mitigation measures.

The use of helicopters for pulling shield wire and conductor lead lines is the normal and expected construction technique for wire stringing, as such, helicopters will be used for this purpose on the Project.

Other Project construction activities potentially facilitated by helicopters may include delivery of construction laborers, equipment, and materials to structure sites; structure placement and hardware installation. Helicopters may also be used to support the administration and management of the Project by the Applicant. Except in areas with restrictions on constructing or maintaining access roads, the use of helicopter construction methods would not change the length of the access road system required for operating the Project, because vehicle access will be required to each structure site regardless of the construction method employed.

When helicopter construction methods are employed, the structure assembly activities will be based at a fly yard. The fly yards will be approximately seven acres and will be sited typically at about five mile intervals within the section of the line employing helicopter erection. Optimum helicopter methods of erection will be used. Bundles of steel members and associated hardware for up to 15 to 20 towers (generally to include insulators, hardware, blocking, stringing sheaves, etc.) are transported to the appropriate fly yard by truck and stored. The steel bundles are opened and laid out by component section and then assembled into assemblies of convenient size and weight according to the helicopter's lifting capabilities. The leg extensions are typically transported to the tower location, assembled, and erected in place (with smaller equipment) in preparation for flying the completed tower sections to each location. After a planned quantity of towers is completely assembled, the helicopter and support force are mobilized and, within a few days, will set all the planned towers within a given section. A follow-up crew will then tighten all the bolts in the joints.

Prior to installation, each tower would be assembled in multiple sections at the fly yard. Tower sections or components would be assembled by weight, based on the lifting capacity of the helicopter in use. The lift capacity of helicopters is dependent on the elevation of the fly yard, the tower site, and the intervening terrain. The heavy lift helicopters that could be used to erect the complete towers or sections of a tower would be able to lift a maximum of 15,000 to 20,000 pounds per flight, depending on elevation.

After assembly at the fly yard, the complete tower or tower section would be attached by cables from the helicopter to the top of the tower section and airlifted to the tower location. Upon arrival at the tower location, the section would be placed directly onto the foundation or atop the previous tower section. Guide brackets attached on top of each section would assist in aligning the stacked sections. Once aligned correctly, line crews would climb the towers to bolt the sections together permanently.

It should be noted that the fly yard locations provided are considered approximate and subject to change, additions, or deletions upon acquisition of a Contractor prior to the beginning of construction. Upon completion of field review, a final determination would be made on the necessity of certain fly yards and the respective locations that provide the most efficient, economic, safest, and least impactful use of the fly yards that are needed.

A helicopter may be used to move personnel and equipment (e.g., pulling lines and assembling towers). Helicopters will set down in areas previously identified to receive temporary disturbance such as fly yards and staging areas. Travelers may be dropped at pulling and tensioning sites or other work areas previously described. Spill protection measures will be in place and all FAA regulations will be followed. Notification will be made to coordinate the air space with other possible helicopters or aircraft in the area (i.e., seeding operations, fire support, and Military Operation Areas).

If needed, additional temporary work areas within close proximity to or on the ROW will be identified by the Contractor and approved by the appropriate land management agency or private landowner for landing and refueling the helicopter. Each fuel truck will be equipped with automatic shutoff valves and will carry spill kits. In addition to the required preventive spill measures, a water truck may be required to spray the site to reduce dust. The Contractor will be required to clean up any materials released on the ROW. Any accidental spills will be handled according to the guidelines presented in the Hazardous Materials Management Plan.

3.5.7.3 Roadless Construction Methods

The proposed TWE Project corridor reference line crosses the edges of six IRAs in three national forests: Atchinson, Mogotsu, and Moody Wash IRAs in Dixie National Forest; 418008 and 418009 IRAs in Uinta-Wasatch-Cache National Forest; and Cedar Knoll IRA in Manti-La Sal National Forest. In total, the proposed TWE Project ROW crosses approximately 10 miles of IRAs of its total 725-mile length. In addition to the standard construction methods planned for the TWE Project, two specialized construction methods can be used where specific conditions are present that restrict the use of standard methods such as can be found in IRAs.

Within these IRAs, the TWE Project could be constructed by one of two specialized construction methods:

1. Construction zone method
2. Helicopter-only construction method

The standard construction methods described in this PDTR are the preferred methods for the TWE Project. Under specific conditions where access road construction is prohibited, the construction zone method eliminates the need for access roads and allows standard construction methods to take place with specialized vehicles. In extreme conditions where access road construction is prohibited and vegetation clearing is not needed along the entire ROW per Level 3 – Selective ROW Clearance-Based Vegetation Management described in Section 3.6.2.1, the helicopter-only construction method would be effective. These two specialized construction methods are described below.

<u>Construction Zone Method</u>

The Applicant is not proposing to build or maintain any temporary or permanent roads across IRAs. The proposed Project will entail establishing a construction zone for the sole purpose of accommodating motorized equipment needed to construct and bring in supplies necessary for the installation of the ±600 kV DC transmission line. There will be no addition of forest classified or temporary road miles for either construction or maintenance of the TWE Project. Existing forest system roads will be used to access the TWE Project transmission line construction ROW.

A 100-foot-wide construction ROW (construction zone) will be used for installing the transmission line. Helicopter construction methods may be used to the extent practical. Vegetation clearing, grading, and temporary work areas within the IRAs would occur within the construction zone. Topsoil will be salvaged and stockpiled. The extent of construction disturbances would be the same or similar, as previously described for the proposed TWE Project standard construction methods. Although construction of the entire Project is anticipated to occur over an approximately three-year period, construction within a particular IRA from initial ground disturbance to start of reclamation is expected to occur over a six to nine month timeframe.

Following the completion of construction activities, the construction zone will be reclaimed. Disturbed areas will be re-contoured, topsoil replaced, and disturbed lands revegetated with vegetation consistent with USFS requirements and the Vegetation Management Plan. Revegetation treatments would be monitored for three to five years, in accordance with USFS requirements. Once the construction zone is reclaimed, routine maintenance would be via aircraft or low-impact vehicles such as vehicles with rubber treading, low pressure tires, or specialized mechanical movement to accommodate the terrain and landscape, and all-terrain vehicles (ATVs), or by non-motorized methods (e.g., foot, horseback, or other non-motorized methods). Unless otherwise approved, the transmission line ROW would only be accessed with motorized equipment for emergency repairs, or to maintain NESC electrical line clearances. Long-term disturbances would include maintenance of a limited ROW width, in which active vegetation management would occur. Authorization for continued vegetation management and emergency repairs would be the responsibility of the USFS and conducted in accordance with the COM Plan and USFS stipulations.

The Applicant will work with the USFS to control the use of the ROW and prevent unauthorized travel along the ROW by off-road vehicles. Measures would be determined in consultation with the USFS and may include the following: a) installing gates or other man-made physical barriers; b) creating natural barriers (e.g. large boulders or debris); and c) stockpiling trees cut for ROW clearing at barrier locations.

Helicopter-Only Construction Method

The Applicant is not proposing to build or maintain any temporary or permanent roads across IRAs. This method would construct the Project in IRAs using helicopter-only construction methods supported by minimal impact overland travel. A detailed description of helicopter construction techniques are provided in Section 3.5.7.2. Helicopters would transport personnel, drilling equipment, towers and other construction materials to and from the ROW and would be used for wire stringing. Access to the ROW also could be accomplished by overland travel using low-impact vehicles as described above for the Construction Zone Method. No blade work would be performed to assist overland travel within the IRAs.

Within an IRA, the structure foundations could be constructed by several methods depending on soil conditions, terrain conditions, and final engineering design. Examples of construction options for installing tower foundations include using precast concrete support pedestals for the guyed steel lattice structures and micro-piles for the self supporting lattice tower foundations transported into the IRA by helicopter or by overland travel using low-impact vehicles. Tower structure sections would be preassembled at approved construction fly yards located outside of the IRAs and airlifted to the tower site locations by helicopter for erection.

Following the completion of construction activities, any temporary disturbance, including any associated with overland travel to access the ROW within the IRA, would be reclaimed and maintained as described above for the Construction Zone Method.

3.5.7.4 Construction in Sensitive Water Resource Areas

Waterbody and Wetland Crossings

Access roads will be designed and constructed to minimize disruption of natural drainage patterns and waterbodies including rivers, streams, ephemeral streams, ponds, lakes, reservoirs, and playas. Structure sites, new access roads, and other disturbed areas will be located away from waterbodies, wherever practicable. Each waterbody crossing will be designed in a distinct segment of the associated access roads as advanced engineering is completed. On all federally-managed lands, the Applicant will consult with the managing agency regarding relevant standards and guidelines pertaining to waterbody road-crossing methods.

Consultation will include site assessment, design, installation, maintenance, and decommissioning of the crossings. Wherever needed, culverts, low-water crossings, and other devices of adequate accepted design will be used to accommodate estimated peak flows of waterways, including crossings of all affected perennial, intermittent, and ephemeral streams. Construction disturbances of banks and beds of waterbodies will be minimized. Performance of low water stream crossings (i.e. drive thru and ford) will be monitored for the life of the access road, and maintained as necessary to preserve water quality. Figure 16 shows typical road designs for low-water crossings and culvert stream crossings.

Potential types of water crossings that would be implemented include:

- **Drive Thru (Arizona Crossing):** Crossing of a channel with minimal vegetation removal where no cut or fill is needed. This is typical for low-precipitation sagebrush country characterized by rolling topography and streams that rarely flow with water.

- **Ford:** Crossing of a channel that includes grading and stabilization. Stream banks and approaches will be graded and stabilized with rock or other erosion control devices to allow vehicle passage. With approval of the land management agency, streambeds in select areas will be reinforced with coarse rock material to support vehicle loads, prevent erosion, and minimize sedimentation of the waterways. Coarse rock will be installed in the streambed in a manner such that it will not raise the level of the streambed, thus allowing continued movement of water, fish, and debris. A typical ford crossing results in a disturbance footprint 25 feet wide (along the waterbody) and 50 feet long (along the roadway) for 1,250 square feet or 0.03 acre of disturbed area at each crossing. The 0.03 acre is based on an estimated disturbance based on the requirement to operate equipment within the riparian area to construct a 14-foot-wide travelway and install armoring to protect it from erosion.

- **Culvert:** Crossing of a waterbody that includes installation of a culvert and construction of a stable road surface for vehicle passage over the culvert. Culverts will be designed and installed under the direction of a qualified engineer who, in collaboration with a hydrologist and an aquatic biologist where required by the land management agency, will specify placement locations; culvert gradient, height, and sizing; and proper construction methods. Culvert design will consider roadbed loading and debris size and volume. The disturbance footprint for a typical culvert installation is estimated to be 50 feet wide (along the waterbody) and 150 feet long (along the road) for 7,500 square feet or 0.17 acre of disturbed area at each crossing. This disturbed area includes approaches to the crossing and side slopes. The amount of area disturbed by excavation and fill material at each crossing will typically be much less and will be determined during final design and engineering. Ground-disturbing activities will comply with agency approved BMPs. Construction will occur during periods of low water or normal flow. The operation of construction equipment in riparian areas will be minimized. All culverts will be designed and installed to meet specified riparian conditions, as identified in applicable unit management plans. Culvert slope will not exceed stream gradient.

  Culverts will typically be partially buried in the streambed to maintain streambed material in the culvert. Sandbags or other non-erosive material will be placed around culverts to prevent scour or water flow outside the culvert. Adjacent sediment control structures such as silt fences, check dams, rock armoring, or riprap may be necessary to prevent erosion or sedimentation. Stream banks and approaches may be stabilized with rock or other erosion control devices. Culverts will be inspected annually for proper operation and maintained to preserve water quality for the life of the Project (estimated at 50 years or longer).

Wetlands will be avoided to the extent possible and practical in siting transmission line structures, terminals, ground electrode systems, temporary work areas, and access roads. Wetlands can typically be spanned by transmission lines to avoid impacts. Temporary access roads requiring a wetland crossing can minimize impacts by implementing timber or other types of mats that can support construction equipment. The use of mats avoids having to fill the wetland causing permanent impacts. Impacts to wetlands and waters of the U.S. will require a CWA Section 404 permit from the U.S. Army Corps of Engineers (USACE), National Pollutant Discharge Elimination System (NPDES) Construction Stormwater Permit (Section 402), and Section 401 water quality certification.

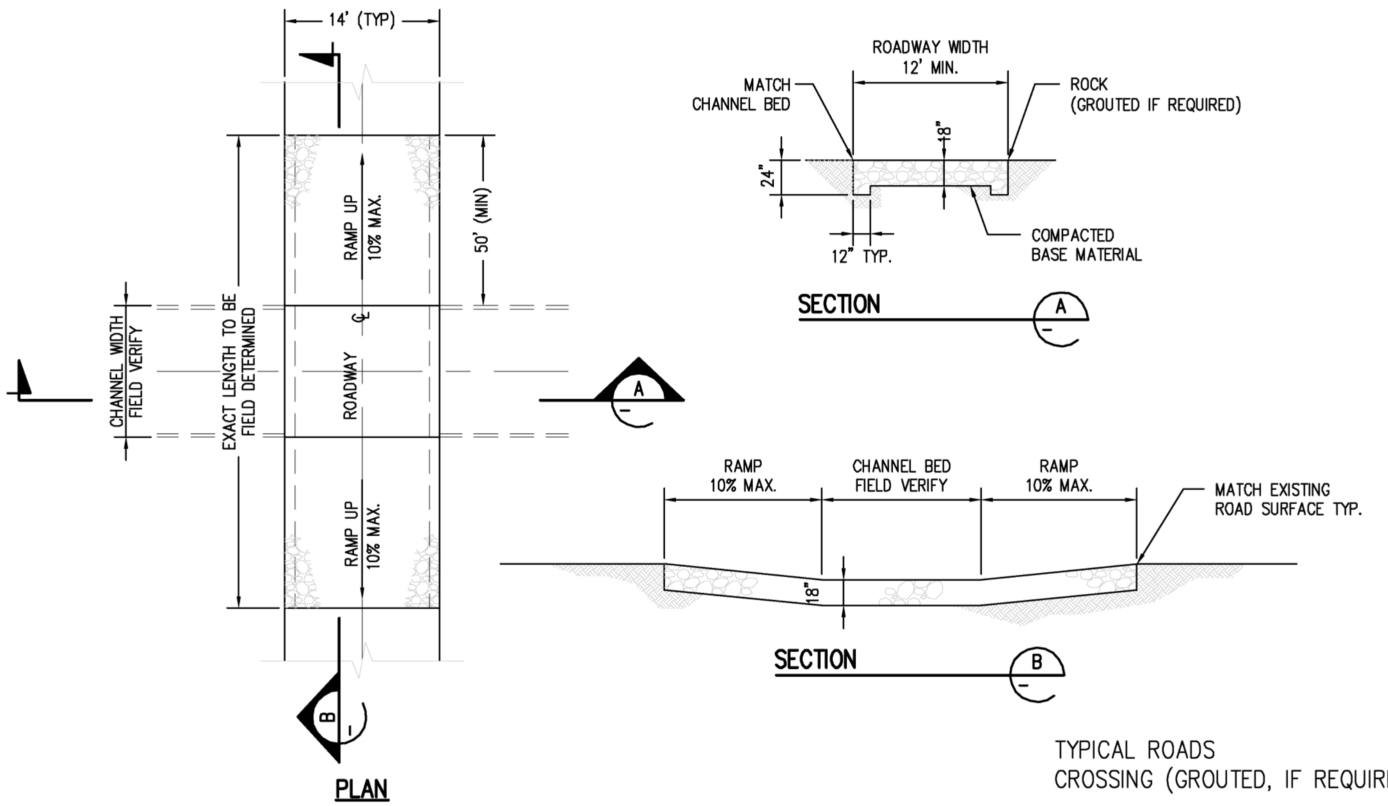
3.5.8 Water Use

Water Uses and Purpose. Construction of the transmission lines and substation/converter stations will require water. Major water uses are for transmission line structure and substation foundations, and dust control during ROW and substation grading and site work. A minor use of water during construction would include the establishment of substation landscaping where required.

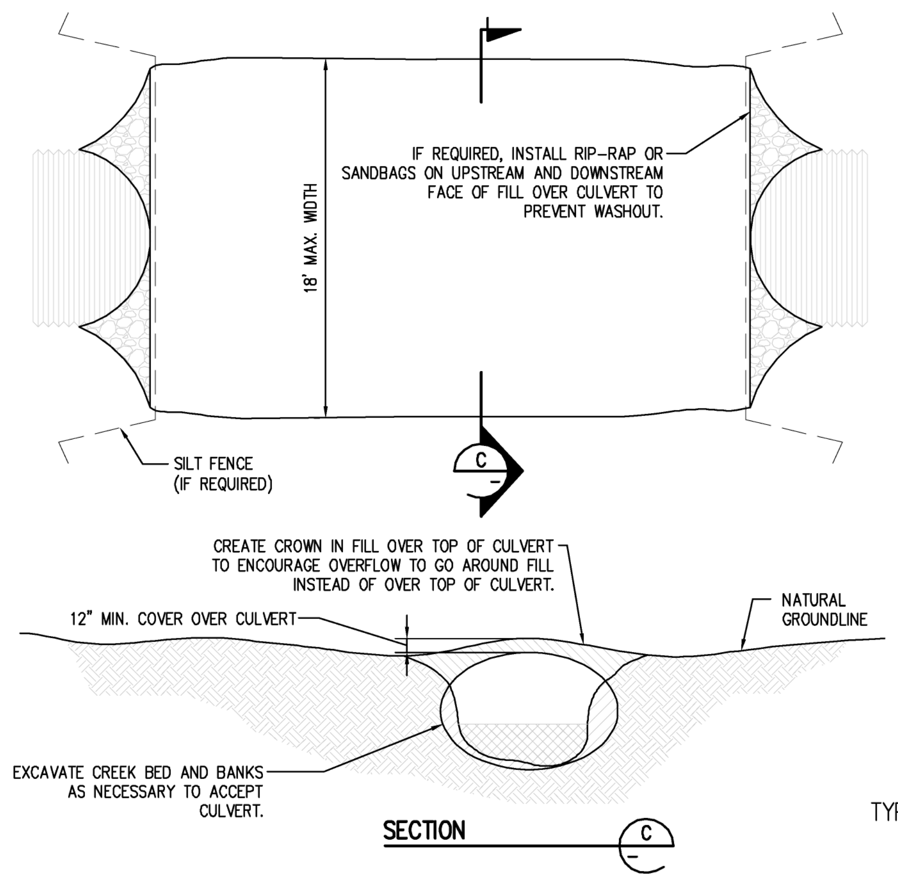
Water usage for transmission line construction is for two primary purposes: foundation construction and ROW dust control. In the construction of foundations, water is transported to the batch plant site where it will be used to produce concrete. From the batch plant, the wet concrete will be transported to the structure site in concrete trucks for use in foundation installation.

Construction of the transmission lines and related facilities will generate a temporary increase in fugitive dust. If the level of fugitive dust is too high in specific project areas, as determined in cooperation with the landowner or agency, water would be applied to disturbed areas to minimize dust.

Water usage for substation/converter station construction is primarily for dust control during site preparation work. During this period, construction equipment would be cutting, moving, and compacting the subgrade surface. As a result, water trucks patrolling the site to control dust would make as many as one pass per hour over the site. Once site preparation work is complete, concrete for the placement of foundations becomes the largest user of water and dust control becomes minimal.



TYPICAL ROADS
CROSSING (GROUTED, IF REQUIRED)



TYPICAL ROADS – CULVERT

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TRANSWEST EXPRESS TRANSMISSION PROJECT
FIGURE 16

TYPICAL ROAD DESIGNS FOR
LOW WATER & CULVERT CROSSINGS

Once site grading is complete, the balance of the substation construction work would be performed on bare subgrade soil or subgrade with a thin layer of rock. Fire risk would be minimal due to the bare ground or rock surface and would be contained within the confines of station-fenced area.

Water Use Estimates. The estimated water required per mile of transmission line construction is approximately 3,400 gallons for foundation concrete and 240,000 gallons for dust control. Water required for construction of the Northern Terminal is estimated to be 600,000 gallons including dust control. Water required for construction of the Southern Terminal is estimated to be 400,000 gallons including dust control due to less disturbance and fewer foundations. Estimated water required for each ground electrode site is 150,000 gallons including dust control. The required water will be procured from municipal sources, from commercial sources, or under a temporary water use agreement with landowners holding existing water rights. No new water rights will be required.

3.5.9 Construction Schedule, Workforce and Equipment

The proposed construction schedule for the TWE Project will be developed for the Agency Preferred Alternative during engineering and design. The construction schedule for the TWE Project will incorporate timing restrictions for special status plant and animal species, as determined by the land management and regulatory agencies in their respective decision documents. For purposes of the DEIS analysis, conceptual schedules have been developed, which provide general estimates on the duration of activities for each of the proposed TWE Project facilities. Conceptual schedules are described in Section 3.5.9.1. Estimated workforce and equipment needs are described in Sections 3.5.9.2 and 3.5.9.3, respectively.

3.5.9.1 Construction Schedule

It is anticipated that total construction timeframe for the transmission line will be approximately three years, concurrent with terminals and ground electrode system construction.

Conceptual schedules for the proposed TWE Project are shown in Figures 17, 18, 19 and 20. Figure 17 provides a bar chart construction schedule for a typical 20-mile stretch of the ±600 kV DC transmission line. Figure 18 shows the entire conceptual schedule for constructing the 725 mile long ±600 kV DC transmission line, including access roads and communication facilities. Figure 19 is a schedule for the proposed Northern and Southern Terminals, and Figure 20 is a construction schedule for the ground electrode systems.

For planning purposes, the overall schedule for the transmission line has been separated into three construction spreads or operations by line segment. The transmission line schedules show a staggered start to allow time for setups, material and equipment logistics and coordination between spreads. The total elapsed time of the combined transmission line schedule is approximately 137 weeks. These construction schedules include consideration for the anticipated conditions; however, severe winter weather, delays in equipment manufacturing and/or delivery, seasonal restrictions required for permitting and/or unexpected mitigation could interrupt the schedule inserting delays of weeks to several months or more.

Construction spreads for the transmission line are anticipated at three different locations. The approximate geographic locations are: (1) Northern Terminal to North-East Utah (approximately 221 miles); (2) North-East Utah to West-Central Utah (approximately 235 miles); and (3) West-Central Utah to the Southern Terminal (approximately 269 miles). The line construction will progress simultaneously at these locations. The construction spreads for the transmission line have been designed such that one or more Contractors may be employed to construct the complete line.

The duration of transmission line construction activities on any given parcel of land may extend up to a year, although the total amount of time of actual construction activity would be much shorter, in the range of a few months. Over any particular section of the route, transmission line construction would be characterized by short periods (ranging from a day to one to two weeks) of relatively intense activity interspersed with periods with no activity. Figure 17 illustrates the typical durations for the construction of a 20-mile section of the transmission line.

The construction of the Northern and Southern Terminals is planned to start approximately three to six months after the start of the construction of the transmission line and run concurrently. The total elapsed time is scheduled for approximately two years. These construction schedules include consideration for the anticipated conditions; however, severe winter weather at the Northern Terminal could interrupt the schedule inserting delays of weeks to several months or more.

TASK	DURATION (WEEKS)
SURVEY / STAKE ACCESS ROADS & STRUCTURE PADS	2.5
CONSTRUCT ACCESS ROADS AND / OR STRUCTURE PADS	2.5
GEOLOGICAL INVESTIGATIONS	3
SURVEY / STAKE STRUCTURE LOCATIONS	3
EXCAVATE HOLES FOR SELF SUPPORTING LATTICE STRUCTURE	1
INSTALL FOUNDATIONS FOR SELF SUPPORTING LATTICE STRUCTURE	1
HAUL MATERIALS FOR SELF SUPPORTING LATTICE STRUCTURE	3
ASSEMBLE SELF SUPPORTING LATTICE STRUCTURE	3
ERECT SELF SUPPORTING LATTICE STRUCTURE	4
WIRE INSTALLATION	3
FINAL CLEAN UP / RECLAMATION / RESTORATION	4

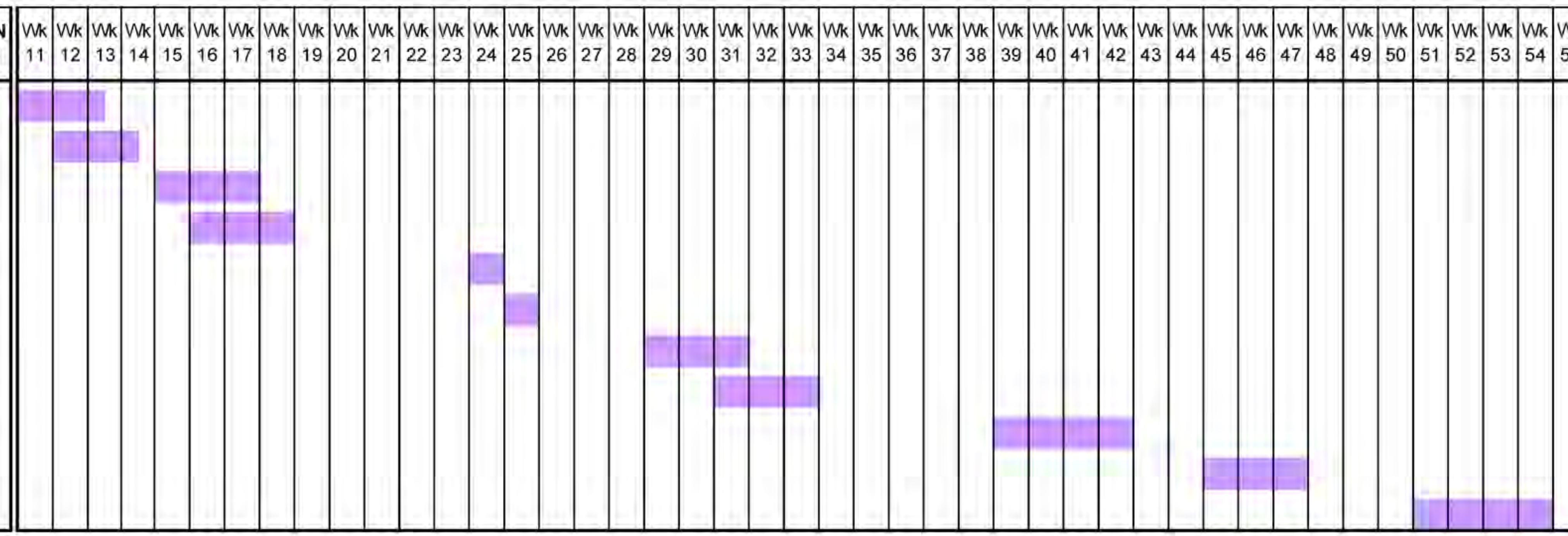

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FIGURE 17
CONSTRUCTION SCHEDULE FOR 20 MILE SECTION OF ±600kV DC TRANSMISSION LINE

SECTION 1 - APPROXIMATELY 221 MILES
NORTHERN TERMINAL - NORTHEASTERN UTAH
(NORTHERN TERMINAL - ROUTE SEGMENT U50)

TOTAL DURATION: 111 weeks

TASK	DURATION (WEEKS)
CONSTRUCTION MANAGEMENT / ENGINEERING SUPPORT / ADMINISTRATION	111
INSPECTION	109
MOBILIZE CONTRACTOR	6
RECEIVE / HANDLE MATERIALS	109
SURVEY / STAKE ACCESS ROADS & STRUCTURE PADS	49
CONSTRUCT ACCESS ROADS AND / OR STRUCTURE PADS	49
GEOLOGICAL INVESTIGATIONS	56
SURVEY / STAKE STRUCTURE LOCATIONS	56
EXCAVATE HOLES FOR SELF SUPPORTING LATTICE STRUCTURE	67
INSTALL FOUNDATIONS FOR SELF SUPPORTING LATTICE STRUCTURE	67
HAUL MATERIALS FOR SELF SUPPORTING LATTICE STRUCTURE	60
ASSEMBLE SELF SUPPORTING LATTICE STRUCTURE	60
ERECT SELF SUPPORTING LATTICE STRUCTURE	70
WIRE INSTALLATION	61
FINAL CLEAN UP / RECLAMATION / RESTORATION	70

SECTION 2 - APPROXIMATELY 235 MILES
NORTHEASTERN UTAH - WEST CENTRAL UTAH
(ROUTE SEGMENT U55 - ROUTE SEGMENT U210)

TOTAL DURATION: 131 weeks

TASK	DURATION (WEEKS)
CONSTRUCTION MANAGEMENT / ENGINEERING SUPPORT / ADMINISTRATION	131
INSPECTION	129
MOBILIZE CONTRACTOR	6
RECEIVE / HANDLE MATERIALS	129
SURVEY / STAKE ACCESS ROADS & STRUCTURE PADS	60
CONSTRUCT ACCESS ROADS AND / OR STRUCTURE PADS	60
GEOLOGICAL INVESTIGATIONS	69
SURVEY / STAKE STRUCTURE LOCATIONS	69
EXCAVATE HOLES FOR SELF SUPPORTING LATTICE STRUCTURE	83
INSTALL FOUNDATIONS FOR SELF SUPPORTING LATTICE STRUCTURE	83
HAUL MATERIALS FOR SELF SUPPORTING LATTICE STRUCTURE	75
ASSEMBLE SELF SUPPORTING LATTICE STRUCTURE	75
ERECT SELF SUPPORTING LATTICE STRUCTURE	87
WIRE INSTALLATION	76
FINAL CLEAN UP / RECLAMATION / RESTORATION	87

SECTION 3 - APPROXIMATELY 269 MILES
WEST CENTRAL UTAH - SOUTHERN TERMINAL
(ROUTE SEGMENT U220 - SOUTHERN TERMINAL)

TOTAL DURATION: 120 weeks

TASK	DURATION (WEEKS)
CONSTRUCTION MANAGEMENT / ENGINEERING SUPPORT / ADMINISTRATION	120
INSPECTION	118
MOBILIZE CONTRACTOR	6
RECEIVE / HANDLE MATERIALS	118
SURVEY / STAKE ACCESS ROADS & STRUCTURE PADS	56
CONSTRUCT ACCESS ROADS AND / OR STRUCTURE PADS	56
GEOLOGICAL INVESTIGATIONS	64
SURVEY / STAKE STRUCTURE LOCATIONS	64
EXCAVATE HOLES FOR SELF SUPPORTING LATTICE STRUCTURE	75
INSTALL FOUNDATIONS FOR SELF SUPPORTING LATTICE STRUCTURE	75
HAUL MATERIALS FOR SELF SUPPORTING LATTICE STRUCTURE	70
ASSEMBLE SELF SUPPORTING LATTICE STRUCTURE	70
ERECT SELF SUPPORTING LATTICE STRUCTURE	80
WIRE INSTALLATION	70
FINAL CLEAN UP / RECLAMATION / RESTORATION	80

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TRANSWEST EXPRESS TRANSMISSION PROJECT
FIGURE 18
CONSTRUCTION SCHEDULE FOR ±600kV DC TRANSMISSION LINE BY SEGMENT
SHEET 1

SECTION 1 - APPROXIMATELY 221 MILES
NORTHERN TERMINAL - NORTHEASTERN UTAH
(NORTHERN TERMINAL - ROUTE SEGMENT U50)

TOTAL DURATION 111 weeks

TASK	DURATION (WEEKS)
CONSTRUCTION MANAGEMENT / ENGINEERING SUPPORT / ADMINISTRATION	111
INSPECTION	109
MOBILIZE CONTRACTOR	6
RECEIVE / HANDLE MATERIALS	109
SURVEY / STAKE ACCESS ROADS & STRUCTURE PADS	49
CONSTRUCT ACCESS ROADS AND / OR STRUCTURE PADS	49
GEOLOGICAL INVESTIGATIONS	56
SURVEY / STAKE STRUCTURE LOCATIONS	56
EXCAVATE HOLES FOR SELF SUPPORTING LATTICE STRUCTURE	67
INSTALL FOUNDATIONS FOR SELF SUPPORTING LATTICE STRUCTURE	67
HAUL MATERIALS FOR SELF SUPPORTING LATTICE STRUCTURE	60
ASSEMBLE SELF SUPPORTING LATTICE STRUCTURE	60
ERECT SELF SUPPORTING LATTICE STRUCTURE	70
WIRE INSTALLATION	61
FINAL CLEAN UP / RECLAMATION / RESTORATION	70

SECTION 2 - APPROXIMATELY 235 MILES
NORTHEASTERN UTAH - WEST CENTRAL UTAH
(ROUTE SEGMENT U55 - ROUTE SEGMENT U210)

TOTAL DURATION 131 weeks

TASK	DURATION (WEEKS)
CONSTRUCTION MANAGEMENT / ENGINEERING SUPPORT / ADMINISTRATION	131
INSPECTION	129
MOBILIZE CONTRACTOR	6
RECEIVE / HANDLE MATERIALS	129
SURVEY / STAKE ACCESS ROADS & STRUCTURE PADS	60
CONSTRUCT ACCESS ROADS AND / OR STRUCTURE PADS	60
GEOLOGICAL INVESTIGATIONS	69
SURVEY / STAKE STRUCTURE LOCATIONS	69
EXCAVATE HOLES FOR SELF SUPPORTING LATTICE STRUCTURE	83
INSTALL FOUNDATIONS FOR SELF SUPPORTING LATTICE STRUCTURE	83
HAUL MATERIALS FOR SELF SUPPORTING LATTICE STRUCTURE	75
ASSEMBLE SELF SUPPORTING LATTICE STRUCTURE	75
ERECT SELF SUPPORTING LATTICE STRUCTURE	87
WIRE INSTALLATION	76
FINAL CLEAN UP / RECLAMATION / RESTORATION	87

SECTION 3 - APPROXIMATELY 269 MILES
WEST CENTRAL UTAH - SOUTHERN TERMINAL
(ROUTE SEGMENT U220 - SOUTHERN TERMINAL)

TOTAL DURATION 120 weeks

TASK	DURATION (WEEKS)
CONSTRUCTION MANAGEMENT / ENGINEERING SUPPORT / ADMINISTRATION	120
INSPECTION	118
MOBILIZE CONTRACTOR	6
RECEIVE / HANDLE MATERIALS	118
SURVEY / STAKE ACCESS ROADS & STRUCTURE PADS	56
CONSTRUCT ACCESS ROADS AND / OR STRUCTURE PADS	56
GEOLOGICAL INVESTIGATIONS	64
SURVEY / STAKE STRUCTURE LOCATIONS	64
EXCAVATE HOLES FOR SELF SUPPORTING LATTICE STRUCTURE	75
INSTALL FOUNDATIONS FOR SELF SUPPORTING LATTICE STRUCTURE	75
HAUL MATERIALS FOR SELF SUPPORTING LATTICE STRUCTURE	70
ASSEMBLE SELF SUPPORTING LATTICE STRUCTURE	70
ERECT SELF SUPPORTING LATTICE STRUCTURE	80
WIRE INSTALLATION	70
FINAL CLEAN UP / RECLAMATION / RESTORATION	80

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TRANSWEST EXPRESS TRANSMISSION PROJECT
FIGURE 18

CONSTRUCTION SCHEDULE FOR
±600kV DC TRANSMISSION LINE BY SEGMENT
SHEET 2

SECTION 1 - APPROXIMATELY 221 MILES
NORTHERN TERMINAL - NORTHEASTERN UTAH
(NORTHERN TERMINAL - ROUTE SEGMENT U50)

TOTAL DURATION 111 weeks

TASK	DURATION (WEEKS)	Wk 109	Wk 110	Wk 111	Wk 112	Wk 113	Wk 114	Wk 115	Wk 116	Wk 117	Wk 118	Wk 119	Wk 120	Wk 121	Wk 122	Wk 123	Wk 124	Wk 125	Wk 126	Wk 127	Wk 128	Wk 129	Wk 130	Wk 131	Wk 132	Wk 133	Wk 134	Wk 135	Wk 136	Wk 137	Wk 138	Wk 139	Wk 140
CONSTRUCTION MANAGEMENT / ENGINEERING SUPPORT / ADMINISTRATION	111																																
INSPECTION	109																																
MOBILIZE CONTRACTOR	6																																
RECEIVE / HANDLE MATERIALS	109																																
SURVEY / STAKE ACCESS ROADS & STRUCTURE PADS	49																																
CONSTRUCT ACCESS ROADS AND / OR STRUCTURE PADS	49																																
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FINAL CLEAN UP / RECLAMATION / RESTORATION	70																																

SECTION 2 - APPROXIMATELY 235 MILES
NORTHEASTERN UTAH - WEST CENTRAL UTAH
(ROUTE SEGMENT U55 - ROUTE SEGMENT U210)

TOTAL DURATION 131 weeks

TASK	DURATION (WEEKS)	Wk 109	Wk 110	Wk 111	Wk 112	Wk 113	Wk 114	Wk 115	Wk 116	Wk 117	Wk 118	Wk 119	Wk 120	Wk 121	Wk 122	Wk 123	Wk 124	Wk 125	Wk 126	Wk 127	Wk 128	Wk 129	Wk 130	Wk 131	Wk 132	Wk 133	Wk 134	Wk 135	Wk 136	Wk 137	Wk 138	Wk 139	Wk 140
CONSTRUCTION MANAGEMENT / ENGINEERING SUPPORT / ADMINISTRATION	131																																
INSPECTION	129																																
MOBILIZE CONTRACTOR	6																																
RECEIVE / HANDLE MATERIALS	129																																
SURVEY / STAKE ACCESS ROADS & STRUCTURE PADS	60																																
CONSTRUCT ACCESS ROADS AND / OR STRUCTURE PADS	60																																
GEOLOGICAL INVESTIGATIONS	69																																
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INSTALL FOUNDATIONS FOR SELF SUPPORTING LATTICE STRUCTURE	83																																
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ERECT SELF SUPPORTING LATTICE STRUCTURE	87																																
WIRE INSTALLATION	76																																
FINAL CLEAN UP / RECLAMATION / RESTORATION	87																																

SECTION 3 - APPROXIMATELY 269 MILES
WEST CENTRAL UTAH - SOUTHERN TERMINAL
(ROUTE SEGMENT U220 - SOUTHERN TERMINAL)

TOTAL DURATION 120 weeks

TASK	DURATION (WEEKS)	Wk 109	Wk 110	Wk 111	Wk 112	Wk 113	Wk 114	Wk 115	Wk 116	Wk 117	Wk 118	Wk 119	Wk 120	Wk 121	Wk 122	Wk 123	Wk 124	Wk 125	Wk 126	Wk 127	Wk 128	Wk 129	Wk 130	Wk 131	Wk 132	Wk 133	Wk 134	Wk 135	Wk 136	Wk 137	Wk 138	Wk 139	Wk 140
CONSTRUCTION MANAGEMENT / ENGINEERING SUPPORT / ADMINISTRATION	120																																
INSPECTION	118																																
MOBILIZE CONTRACTOR	6																																
RECEIVE / HANDLE MATERIALS	118																																
SURVEY / STAKE ACCESS ROADS & STRUCTURE PADS	56																																
CONSTRUCT ACCESS ROADS AND / OR STRUCTURE PADS	56																																
GEOLOGICAL INVESTIGATIONS	64																																
SURVEY / STAKE STRUCTURE LOCATIONS	64																																
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FINAL CLEAN UP / RECLAMATION / RESTORATION	80																																

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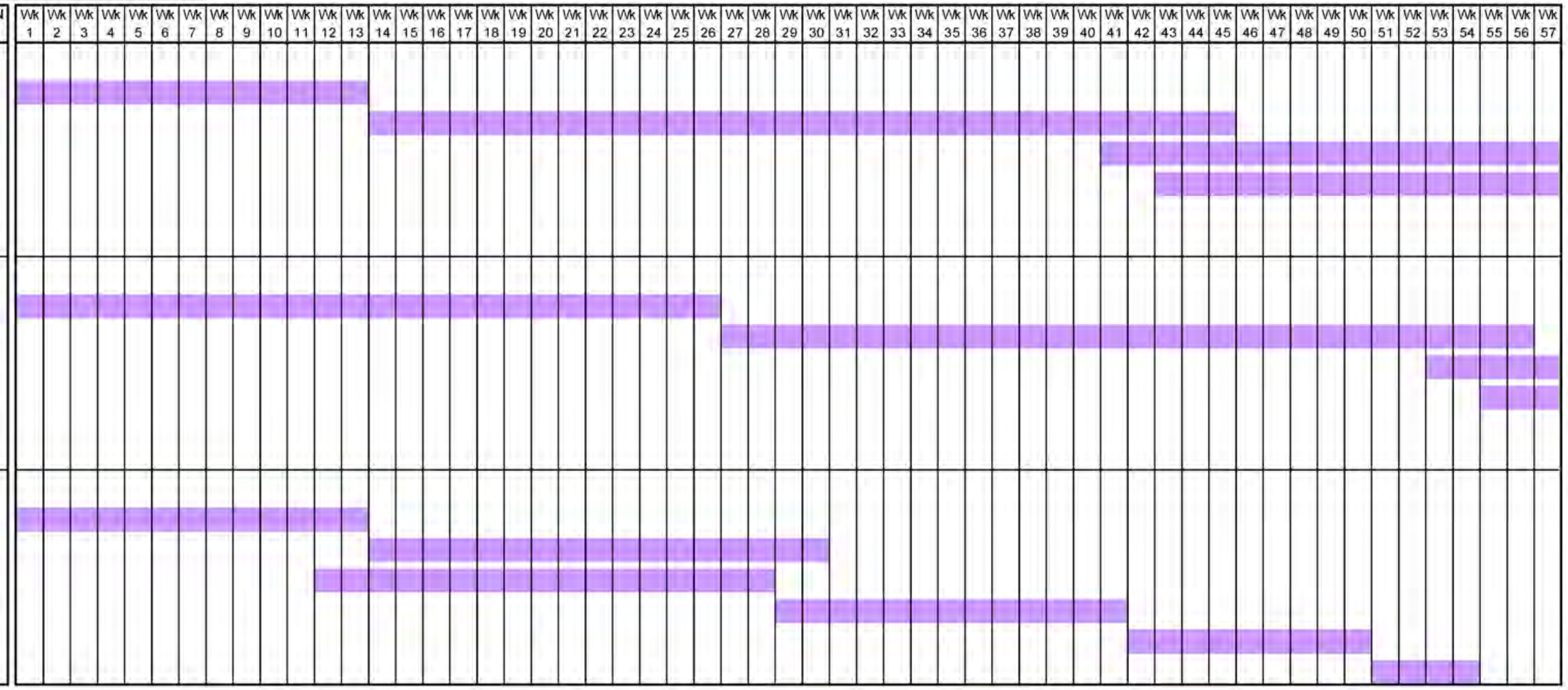
TRANSWEST EXPRESS TRANSMISSION PROJECT
FIGURE 18
CONSTRUCTION SCHEDULE FOR ±600kV DC TRANSMISSION LINE BY SEGMENT
SHEET 3

NORTHERN TERMINAL

TOTAL DURATION: 111 week

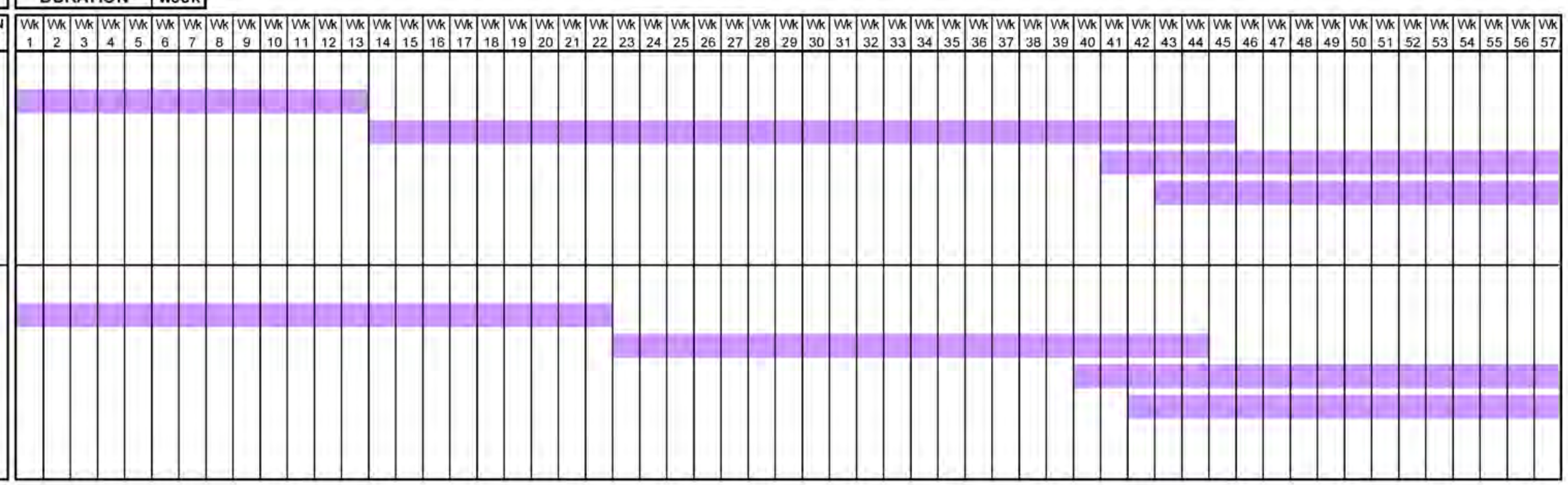
TASK	DURATION (WEEKS)
AC/DC CONVERTER STATION	
SITE GRADING	13
BELOW-GRADE WORK (FOUNDATIONS, CONDUIT, GROUNDING)	32
BUILDING CONSTRUCTION	35
EQUIPMENT INSTALLATION	39
EQUIPMENT TESTING	21
OPERATIONAL	9
500 kV AC SUBSTATION	
SITE GRADING	26
BELOW-GRADE WORK (FOUNDATIONS, CONDUIT, GROUNDING)	30
BUILDING CONSTRUCTION	34
EQUIPMENT INSTALLATION	30
EQUIPMENT TESTING	17
OPERATIONAL	7
230 kV AC SUBSTATION	
SITE GRADING	13
BELOW-GRADE WORK (FOUNDATIONS, CONDUIT, GROUNDING)	17
BUILDING CONSTRUCTION	17
EQUIPMENT INSTALLATION	13
EQUIPMENT TESTING	9
OPERATIONAL	4



SOUTHERN TERMINAL

TOTAL DURATION: 111 week

TASK	DURATION (WEEKS)
AC/DC CONVERTER STATION	
SITE GRADING	13
BELOW-GRADE WORK (FOUNDATIONS, CONDUIT, GROUNDING)	32
BUILDING CONSTRUCTION	35
EQUIPMENT INSTALLATION	39
EQUIPMENT TESTING	21
OPERATIONAL	9
500 kV AC SUBSTATION	
SITE GRADING	22
BELOW-GRADE WORK (FOUNDATIONS, CONDUIT, GROUNDING)	22
BUILDING CONSTRUCTION	26
EQUIPMENT INSTALLATION	22
EQUIPMENT TESTING	13
OPERATIONAL	6



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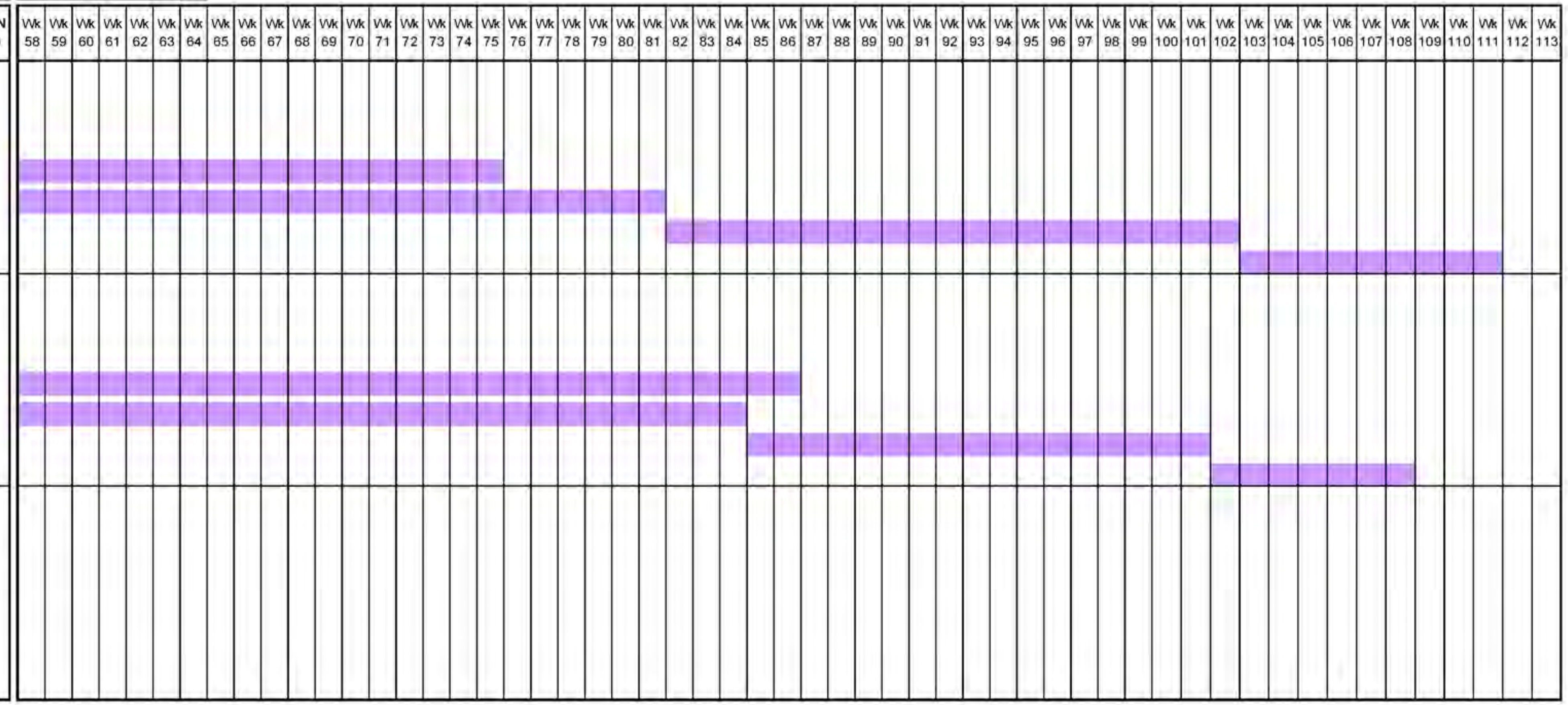
TRANSWEST EXPRESS TRANSMISSION PROJECT
FIGURE 19
CONSTRUCTION SCHEDULE FOR NORTHERN & SOUTHERN TERMINALS
SHEET 1

NORTHERN TERMINAL

TOTAL DURATION	111 week

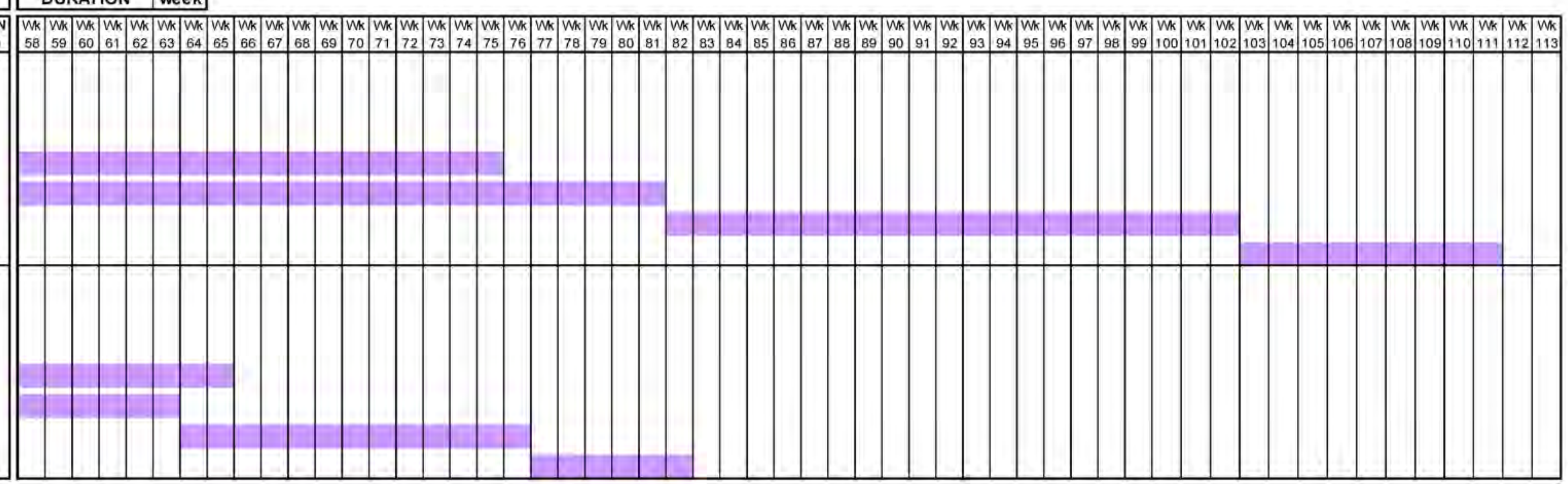
TASK	DURATION (WEEKS)
AC/DC CONVERTER STATION	
SITE GRADING	13
BELOW-GRADE WORK (FOUNDATIONS, CONDUIT, GROUNDING)	32
BUILDING CONSTRUCTION	35
EQUIPMENT INSTALLATION	39
EQUIPMENT TESTING	21
OPERATIONAL	9
500 kV AC SUBSTATION	
SITE GRADING	26
BELOW-GRADE WORK (FOUNDATIONS, CONDUIT, GROUNDING)	30
BUILDING CONSTRUCTION	34
EQUIPMENT INSTALLATION	30
EQUIPMENT TESTING	17
OPERATIONAL	7
230 kV AC SUBSTATION	
SITE GRADING	13
BELOW-GRADE WORK (FOUNDATIONS, CONDUIT, GROUNDING)	17
BUILDING CONSTRUCTION	17
EQUIPMENT INSTALLATION	13
EQUIPMENT TESTING	9
OPERATIONAL	4



SOUTHERN TERMINAL

TOTAL DURATION	111 week

TASK	DURATION (WEEKS)
AC/DC CONVERTER STATION	
SITE GRADING	13
BELOW-GRADE WORK (FOUNDATIONS, CONDUIT, GROUNDING)	32
BUILDING CONSTRUCTION	35
EQUIPMENT INSTALLATION	39
EQUIPMENT TESTING	21
OPERATIONAL	9
500 kV AC SUBSTATION	
SITE GRADING	22
BELOW-GRADE WORK (FOUNDATIONS, CONDUIT, GROUNDING)	22
BUILDING CONSTRUCTION	26
EQUIPMENT INSTALLATION	22
EQUIPMENT TESTING	13
OPERATIONAL	6



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TRANSWEST EXPRESS TRANSMISSION PROJECT
FIGURE 19
CONSTRUCTION SCHEDULE FOR NORTHERN & SOUTHERN TERMINALS
SHEET 2

CONSTRUCTION SCHEDULE FOR ONE GROUND ELECTRODE LOCATION

TASK	DURATION (WEEKS)
SITE GRADING	3
DRILLING 60 WELLS	8
EXCAVATE CABLE TRENCHES	6
BUILD CONCRETE CABLE TRENCHES	10
INSTALL ELECTRODE ELEMENTS	8
INSTALL LV CABLES, SWITCHES	4
INSTALL TEMPERATURE & CURRENT TRANSDUCERS, WIRING	2
BUILD CONTROL / COMMUNICATION BUILDING & FENCED AREA	8
INSTALL SITE COMMUNICATIONS EQUIPMENT, SCADA	4
ELECTRODE COMMISSIONING*	8

Week columns: Wk 1 – Wk 38

*PERFORMED AFTER CONVERTER STATIONS ARE FUNCTIONAL

CONSTRUCTION SCHEDULE FOR LOW VOLTAGE TRANSMISSION LINE (10 MILES ASSUMED)

TASK	DURATION (WEEKS)
SURVEY / STAKE ACCESS ROADS & STRUCTURE PADS	3
CONSTRUCT ACCESS ROADS AND / OR STRUCTURE PADS	4
FOUNDATION EXCAVATION	3
HAUL STRUCTURES	3
INSTALL STRUCTURES	4
INSTALL WIRES	2
FINAL CLEAN UP / RECLAMATION / RESTORATION	4

Week columns: Wk 1 – Wk 38

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TRANSWEST EXPRESS TRANSMISSION PROJECT
FIGURE 20
CONSTRUCTION SCHEDULE FOR GROUND ELECTRODE SYSTEM

3.5.9.2 Construction Workforce

The proposed TWE Project will be constructed by contract personnel, with the Applicant responsible for project management, project administration and inspection. The construction workforce will consist of laborers, craftsmen, supervisory personnel, support personnel, and construction management personnel who will perform the construction tasks. Estimated construction workforce requirements by major activity are summarized in Tables 6 and 7.

Table 6 identifies the estimated personnel and equipment that is required for each of the three transmission line spreads. The total estimated number of construction personnel for construction of the entire transmission line is 630 people. Table 7 identifies the estimated personnel and equipment that is required for each of the two terminals and each of the two ground electrodes. The total estimated number of construction personnel for construction of both terminals and both ground electrodes is 360 people. The total estimated workforce for the complete proposed Project is approximately 1,000 people.

Construction will generally occur between 7 a.m. and 7 p.m., Monday through Saturday. Additional hours may be necessary to make up schedule deficiencies or to complete critical construction activities.

Temporary work camps are not expected to be necessary for the construction of the TWE Project. Variables considered in determining if work camps would be required are:

- The total distance between living facilities for construction workers and designated work areas. A general one-way travel time of two hours may be considered as a limit in determining if temporary work camps are necessary.
- Workers' Union wage agreement regarding the driving time one-way (to worksite) or round trip (to/from worksite). If the agreement allows for driving time then the camp consideration may not be required.
- The ability of existing communities to provide housing for workers or to make improvements to meet the workers' accommodation demands.
- Socioeconomic impacts on communities along the route with or without the work camps.
- Economic feasibility of permitting a work camp.
- Service life of the work camps and the restoration requirements after tear down.

The TWE Project does not appear to have areas that are more than 50 miles (on paved roads) from the ROW to existing communities or towns. The average travel distance for the Project is approximately 15 miles. The populations of these towns indicate their capability to handle the housing and/or accommodation demands of the construction workers. It should be noted during typical transmission line construction, the entire work force and support personnel generally do not all work in one area at any given time. Generally one or more activities are completed and the associated crews move to a new location prior to all the other activities becoming fully operational in that area. Section 3.5 describes the construction process, including construction workforce levels and numbers of workers by activities.

3.5.9.3 Construction Equipment

Equipment required for construction of the TWE Project transmission lines, terminals and ground electrode systems will include, but is not limited to, that listed in Tables 6 and 7.

TABLE 6	ESTIMATED PERSONNEL AND EQUIPMENT FOR TRANSMISSION LINE CONSTRUCTION FOR EACH SPREAD		
ACTIVITY	PEOPLE	QUANTITY AND TYPE OF EQUIPMENT	
Survey Crew	6	2	Pickup trucks
		2	ATV
Geologic/Geotechnical Investigations	6	2	Pickup trucks, 4-wheel drive
		1	ATV
		2	Rubber tire drill trucks (2-ton)
Road Construction Crew	6	2	Dozer (D-8 Cat or equivalent)
		1	Motor grader
		1	Pickup truck
		2	Carry alls
		1	Water truck (for construction and maintenance)
		1	Dump truck
		1	Front end loader
		1	Diesel tractor w/lowboy
Foundation Installation Crew	26	4	Hole diggers
		2	Dozers
		2	Trucks (2-ton)
		2	Trucks, flatbed, w/boom (5-ton)
		4	Concrete trucks
		2	Dump trucks
		2	Diesel tractors (equipment hauling)
		3	Pickup trucks
		1	Mechanics truck
		1	Water truck
		1	Carry all
		2	Cranes, all terrain (35-ton)
		1	Front end loader
		1	Backhoe, w/bucket
		1	Wagon drill
		3	Equipment-tool trailers
Anchor Installation	20	2	Pickup trucks

TABLE 6	ESTIMATED PERSONNEL AND EQUIPMENT FOR TRANSMISSION LINE CONSTRUCTION FOR EACH SPREAD		
ACTIVITY	PEOPLE	QUANTITY AND TYPE OF EQUIPMENT	
		4	Carry alls
		1	Truck, flatbed (2-ton)
		2	Trucks, flatbed, w/boom (5-ton)
		1	Dump truck
		1	Water truck
		2	Concrete trucks
		1	Mechanics truck
		2	Diesel tractors, w/lowboy
		2	Dozers
		1	Loader, front end
		3	Backhoes, w/bucket
		3	Wagon drills
		3	Cranes, all terrain (35-ton)
Structure Steel Haul Crew	8	1	Equipment-tool trailer
		2	Diesel tractors (steel hauling)
		1	Pickup truck
		1	Truck, flatbed (2-ton)
		1	Carry all
		5	Cranes, all terrain (35-ton)
		3	Fork lifts
Structure Assembly Crews 8-9 Crews	72	2	Pickup trucks
		10	Carry alls
		5	Cranes, all terrain (35-ton)
		1	Water truck
		5	Air compressors
		2	Trucks (2-ton)
		1	Mechanics truck
		2	Tool-equipment trailers
Structure Erection Crews 1-2 Crews	20	2	Cranes (120 – 300-ton)
		2	Trucks (2-ton)

TABLE 6	ESTIMATED PERSONNEL AND EQUIPMENT FOR TRANSMISSION LINE CONSTRUCTION FOR EACH SPREAD		
ACTIVITY	PEOPLE	QUANTITY AND TYPE OF EQUIPMENT	
		2	Pickup trucks
		5	Carry alls
		1	Mechanics truck
		2	Air compressors
		1	Tool-equipment trailer
Wire Installation Crew	36	6	Wire reel trailers
		4	Haul trailers
		4	Diesel tractors
		4	Cranes (2) 20-ton, (2) 30-ton
		5	Trucks, flatbed, w/bucket (5 -ton)
		4	Pickup trucks
		2	Splicing trucks
		2	3-drum pullers (one medium, one heavy)
		2	Single drum pullers (large)
		1	Backhoe, w/bucket
		1	Water truck
		2	Trucks, flatbed (2-ton)
		4	Double bull-wheel tensioner (two light and two heavy)
		2	Sagging equipment (D-8 Cat)
		6	Carry alls
		2	Static wire reel trailers
		3	Tool-equipment trailers
		2	Mechanics trucks
Clean-up Crew	4	1	Truck, flatbed, w/bucket (5-ton)
		1	Pickup truck
		1	Carry all
Road Rehabilitation Crew (ROW Restoration)	6	1	Dozer (D-8 Cat or equivalent)
		1	Front end loader w/bucket
		1	Backhoe, w/bucket
		1	Diesel tractor, w/lowboy

TABLE 6	ESTIMATED PERSONNEL AND EQUIPMENT FOR TRANSMISSION LINE CONSTRUCTION FOR EACH SPREAD		
ACTIVITY	PEOPLE	QUANTITY AND TYPE OF EQUIPMENT	
		1	Seeding/harrowing equipment, w/tractor
		1	Motor grader
		1	Pickup truck
		1	Dump truck
		1	Carry all
Estimated maximum personnel required for all transmission line tasks including maintenance, management, and quality control personnel = 210 for each of the three spreads.			

TABLE 7	ESTIMATED PERSONNEL AND EQUIPMENT FOR EACH TERMINAL AND GROUND ELECTRODE SYSTEM		
ACTIVITY	PEOPLE	QUANTITY AND TYPE OF EQUIPMENT	
Survey Crew	4	2	Pickup trucks
Site Management Crew	10-12	4	Office trailers
		4	Pickups
		4	Generators
Site Development – Civil Work Crew	30-35	4	Scrapers
		2	Dozers (ripper)
		2	Motor graders
		2	Roller compactors
		2	Excavators
		4	Dump trucks
		3	Water trucks
		1	Mechanics truck
		1	Fuel truck
		2	Pickup trucks
		6	Carry alls
Fence Installation Crew	10-20	1	Pickup truck
		1	Boom truck
		2	Carry alls
		1	Backhoe
		1	Concrete truck
		1	Reel stand truck

TABLE 7 ESTIMATED PERSONNEL AND EQUIPMENT FOR EACH TERMINAL AND GROUND ELECTRODE SYSTEM			
ACTIVITY	PEOPLE	QUANTITY AND TYPE OF EQUIPMENT	
		2	Bobcats
Equipment Footings Installation Crew	24-30	2	Hole diggers
		2	Boom trucks
		1	Excavator
		3	Concrete trucks
		1	Dump truck
		1	Roller compactor
		2	Plate compactors
		1	Backhoe
		2	Bobcats
		1	Mechanics truck
		1	Fuel truck
		1	Water truck
		2	Pickup trucks
		4	Carry alls
Cable Trench, Conduits, and Station Grounding Crew	12-16	2	Trenchers
		2	Dozers (ripper)
		2	Roller compactors
		2	Plate compactors
		2	Excavators
		1	Boom truck
		3	Pickup trucks
		2	Flatbed trucks
		4	Carry alls
		1	Air compressor
		1	Backhoe
		1	Mechanics truck
		1	Fuel truck
		1	Dump truck
		1	Reel stand truck

TABLE 7	ESTIMATED PERSONNEL AND EQUIPMENT FOR EACH TERMINAL AND GROUND ELECTRODE SYSTEM		
ACTIVITY	PEOPLE	QUANTITY AND TYPE OF EQUIPMENT	
Steel Structure and Bus Installation Crew, Converter Valve Hall, Ancillary Buildings Construction Crew, Equipment Assembly and Erection Crew	16-24	2	Cranes, RT
		2	High capacity cranes
		4	Boom trucks
		6	Manlifts
		4	Welder trucks
		2	Carry alls
		3	Pickup trucks
		2	Flatbed trucks
		1	Mechanics truck
		4	Vans
		2	Flatbed trucks
Control Building and Wiring Crew	20-24	2	Boom trucks
		4	Manlifts
		3	Wire pullers-small
		2	Reel stand trucks/trailers
		4	Vans
		4	Pickup trucks
		2	Carry alls
		1	Splicing van
		2	Concrete trucks
		1	Bobcat
		1	Trencher
		2	Plate compactors
Ground Electrode Construction Crew	12-18	2	Pickup trucks
		1	Fuel truck
		1	Water truck
		2	Trenchers
		2	Drill rigs
		1	Boom truck
		2	Flatbed trucks

TABLE 7	ESTIMATED PERSONNEL AND EQUIPMENT FOR EACH TERMINAL AND GROUND ELECTRODE SYSTEM		
ACTIVITY	PEOPLE	QUANTITY AND TYPE OF EQUIPMENT	
		1	Bobcat
		1	Backhoe
		1	Mechanics truck
		1	Concrete trucks
		1	Air compressor

The above table reflects estimated personnel requirements, which may reach as high as 180 for each terminal, substation, and ground electrode construction, including maintenance, management, and quality control personnel.

3.6 Proposed TWE Project Operation and Maintenance Practices

The TWE Project ±600 kV DC, 500 kV AC and 230 kV AC transmission lines will comprise critical infrastructure of the Desert Southwest transmission systems and of the western U.S. electrical grid. Limiting the duration of unplanned outages, and planning for the use of live-line maintenance techniques to minimize the requirement for any outages is an important part of the design, construction, and operation/maintenance requirements for this Project.

Regular inspection of transmission lines, terminals, substations, ground electrodes, and support systems is critical for safe, efficient, and economical operation of the Project. Regular ground and aerial inspections will be performed in accordance with the Applicant’s established policies and procedures for transmission line inspection and maintenance (Western 2007). The TWE Project ±600 kV DC, 500 kV AC and 230 kV AC transmission lines, terminals, substations, ground electrode systems, communications system, and other ancillary facilities will be inspected regularly for corrosion, equipment misalignment, loose fittings, vandalism, and other mechanical problems. The need for vegetation management on transmission line ROWs will also be determined during inspection patrols.

3.6.1 Transmission Lines

Inspection of the entire transmission line system will be conducted semi-annually. Aerial inspection will be conducted by helicopter semi-annually and will require two or three crew members, including the pilot. Detailed ground inspections will take place on an annual basis using access roads to each structure. Ground inspection would use 4x4 trucks or 4x4 ATVs for all structures with access roads. For structures in areas without permanent access roads, ground inspection will be on foot or by other approved means. The inspector would assess the condition of the transmission line and hardware to determine if any components need to be repaired or replaced, or if other conditions exist that require maintenance or modification activities. The inspector would also note any unauthorized encroachments and trash dumping on the ROW that could constitute a safety hazard. The inspector would access each of the structure locations along each line and use binoculars and spotting scopes to perform this inspection.

Routine maintenance activities are ordinary maintenance tasks that have historically been performed and are regularly carried out on a routine basis. The work performed is typically repair or replacement of individual components (no new ground disturbance), performed by relatively small crews using a minimum of equipment, and usually is conducted within a period from a few hours up to a few days. Work requires access to the damaged portion of the line to allow for a safe and efficient repair of the facility. Equipment required for this work may include four-wheel-drive trucks, material (flatbed) trucks, bucket trucks (low reach), boom trucks (high reach), or man lifts. This work is scheduled and is typically required due to issues found during inspections. Typical items that may require periodic replacement on structures include insulators, hardware, or structural members. It is expected that these replacements would be required infrequently.

If during transmission line maintenance and monitoring, it is determined that new or reconstruction activities should be implemented, the Applicant will notify the appropriate land management agency or private landowner, and obtain proper approvals, as necessary.

Dust control during maintenance of the transmission line will be managed the same as during construction.

3.6.2 Transmission Line ROW

The Applicant will maintain work areas adjacent to structures and along the ROW for vehicle and equipment access necessary for operations, maintenance, and repair. Where long-term access is required for maintenance of the line, the Applicant will maintain the approved access roads in a safe, useable condition, as directed by an authorized officer from the appropriate land management agency or private landowner.

When needed, ROW repairs may include grading or repair of existing maintenance access roads and work areas, and spot repair of sites subject to erosion, flooding or scouring. Access road maintenance entails activities to ensure that approved access roads are in appropriate condition for access to transmission lines by maintenance and inspection crews. These activities include re-grading, re-surfacing, and re-constructing water diversions such as culverts, ditches and water bars. Required equipment may include a grader, backhoe, four-wheel-drive pickup truck, and a cat-loader or bulldozer. The cat-loader has steel tracks whereas the grader, backhoe, and truck typically have rubber tires. Repairs to the ROW would be scheduled as a result of line inspections, or would occur in response to an emergency situation.

Snow removal, if necessary for terminal, substation, ground electrode and regeneration station access roads, will be performed with blades equipped with shoes to keep the blade off the road surface in order to avoid damage.

Vegetation within the ROWs will be managed in accordance with the TWE Project Vegetation Management Program described in detail below.

3.6.2.1 Vegetation Management Program

A Vegetation Management Program will be developed and implemented for the TWE Project. The Program will be designed to meet NERC reliability requirements in a cost-effective manner, and provide measures for minimizing potential conflicts with critical environmental resources or management issues. The vegetation management program for the TWE Project transmission line ROWs will be based on meeting reliability requirements of NERC through integrative vegetation management (IVM) practices (NERC 2009, ANSI 2006). The TWE Project program will comply with NERC reliability standards.

NERC has established reliability standard FAC-003-2 to prevent vegetation related outages from occurring on bulk transmission systems, which could lead to cascading outages. The standard was developed in response to serious outages and operational problems, which have resulted from interference between overgrown vegetation and transmission lines over the past 10 to 20 years. Compliance with this standard is mandatory. FAC-003-2 requires having and implementing a documented transmission vegetation management program, designed to control vegetation on transmission ROWs (NERC 2009).

IVM is a best management practice conveyed in the American National Standard for Tree Care Operations, Part 7 (ANSI 2006) and the International Society of Arboriculture's *Best Management Practices: Integrated Vegetation Management* (Miller 2007). IVM is consistent with the requirements of FAC-003-2 and is recognized as containing the most appropriate techniques for transmission ROWs to meet and exceed the NERC requirements (NERC 2009). IVM is a system of managing plant communities by setting objectives for desired conditions and identifying and managing ROWs for compatible and incompatible vegetation. Implementation of TWE Project's Vegetation Management Plan will comply with NERC standards through IVM practices. IVM principles will serve as guidance in establishing and maintaining a desired condition for TWE Project ROWs and associated facilities.

3.6.2.2 TWE Project Vegetation Management Plan Framework

The Applicant will develop the Vegetation Management Plan for the Agency Preferred Alternative. The Plan would be developed during Project engineering and design, and would be part of the COM Plan. For purposes of the DEIS analysis, the following provides a framework summary of the draft program, including desired conditions and implementation strategies.

The TWE Project Vegetation Management Program will establish and maintain several levels or types of desired conditions within the TWE Project transmission line ROWs. Potential desired conditions and implementation measures are described below for three levels:

- Level 1 – Standard ROW Vegetation Management
- Level 2 – Selective ROW Wire-Border Zone Vegetation Management
- Level 3 – Selective ROW Clearance Based Vegetation Management

In all settings, the Applicant must meet the NERC requirements and therefore, irrespective of the level of vegetation management applied, site-specific conditions may require a more conservative restrictive vegetation management approach such that the Applicant-defined minimum clearance to vegetation criteria, which complies with NERC, is met.

Level 1 - Standard ROW Vegetation Management

<u>Application and Desired Condition.</u> Level 1 is the Applicant's desired condition for the majority of the TWE Project ROW. Level 1 represents the most effective way to meet and exceed the NERC standards in a cost-effective manner. Level 1 would entail initially clearing the ROW of all undesirable vegetation and managing the ROW to maintain the desired condition.

The Level 1 desired condition is characterized by stable, low growth plant communities, free of noxious or invasive plants. These communities would typically be comprised of herbaceous plants and low growing shrubs, which ideally are native to the local area. Vegetation heights would average three feet in height, and may range between two feet and six feet. Accumulations of vegetation debris from intensive or repetitive vegetation treatments may require mitigation to reduce risks from wildfire and enhance the fire survivability of the transmission facility. The density of remaining vegetation would be a consideration in assessing overall fire risk. Adequate access routes are required and must be maintained to provide for efficient, cost-effective vegetation treatment activities. Figures 21 and 22 illustrate the Level 1 desired conditions.

Implementation. As part of construction, the clearing of the ROW and access roads would be accomplished in accordance with a vegetation clearing specifications plan. As part of the ROW clearing, all danger trees would be identified and removed from the ROW. All trees would be cut off at ground level and the stumps left in place for erosion control. Low-growing trees, shrubs, and ground vegetation would be left in place to the extent possible. At ravine crossings, more woody vegetation would be retained to the extent practical with higher conductor clearances. Vegetation would be cleared at each tower. Clearance zones would extend out 50 feet around self supporting lattice towers and single shaft tubular steel poles. The clearance zone for the guyed lattice towers would extend out 20 feet from the outline of the guy pattern. Figure 23 shows the extents of vegetation clearing planned for the guyed lattice towers. Figure 24 provides comparable information for the tubular steel pole and self supporting lattice towers. Shrubs and ground cover outside these tower clearance zones would be left in place to the extent possible. Commercial timber generated from the ROW clearing would be purchased from the appropriate land management agency or private landowner. Slash would be removed from the Project site or chipped and spread according to approved USFS or BLM practices.

During the life of the TWE Project, the ROW would be managed to retain the Level 1 desired condition in designated areas. During operation, the Applicant would be responsible for routine inspections of vegetation. Annual plans for the inspection and treatment of vegetation would be implemented. The Plan would describe the methods used, such as manual clearing, mechanical clearing, herbicide treatment, or other actions.

Vegetation would be removed using mechanical equipment such as chain saws, weed trimmers, rakes, shovels, mowers, and brush hooks. Clearing efforts in heavy growth areas would use equipment such as a Hydro-Ax or similar. The duration of activities, and the size of crew and equipment required, would depend on the amount and size of the vegetation to be trimmed or removed. In selected areas, herbicides may be used to control noxious weeds and to meet vegetation management objectives. All herbicide applications would be performed in accordance with federal, state, and local regulations, and in compliance with appropriate land management agency or private landowner requirements.

Level 2 – Selective ROW Wire-Border Zone Vegetation Management

Application and Desired Condition. Level 2 is the desired condition for portions of the ROW where highly sensitive or constrained resource or agency management issues have been identified through the NEPA process that can be effectively mitigated with Level 2 vegetation treatment. Level 2 vegetation management would meet the NERC standards, but would be more costly in terms of on-going maintenance. Consequently, Level 2 would be applied selectively to only those portions of the ROW where the implementation of Level 2 would effectively mitigate potential impacts to highly sensitive resources. Examples of areas where Level 2 vegetation management may be appropriate are Visual Resource Management (VRM) Class III landscapes, or sensitive wildlife habitats susceptible to forest fragmentation impacts, where potential impacts can be effectively mitigated with this vegetation measure.

The desired condition of the ROW in Level 2 is based on the Wire Border Zone concept developed by Bramble and Brynes (Bramble, et al. 1985, 1986). The principle objective of the Wire Border Zone concept is to define a simple approach, based on maintaining a minimum clearance from an energized conductor to any type of vegetation, that can be applied to most situations on the transmission line This approach is consistent with the NERC FAC-003-2 regulatory requirements to maintain the required Minimum Vegetation Clearance Distance (MVCD).

NERC FAC-003-2 defines the Wire-Border Zone as a technique that can be applied to the ROW through cultural control. Under this technique, two zones are defined for vegetation management. Figure 25 shows a typical ROW cross-section for the TWE Project ±600 kV DC transmission line and Wire Zone and Border Zone areas. The definition of each and desired conditions are as follows:

Wire Zone. The Wire Zone is defined as the section of the utility ROW that is directly under the wires and extending outward a distance sufficient to accommodate anticipated wire movement. The Wire Zone for this Project is 90 feet in width centered on the centerline of the transmission line. The maximum vegetation height for the desired conditions for Level 2 within the Wire Zone is six feet.

The desired condition for the Wire Zone would be the same as Level 1 and characterized by stable, low-growth plant communities, free of noxious or invasive plants. These communities would typically be comprised of herbaceous plants and low-growing shrubs, which ideally are native to the local area. Vegetation heights would average three feet in height, and may range between two feet and six feet. Refer to Level 1 for full definition.

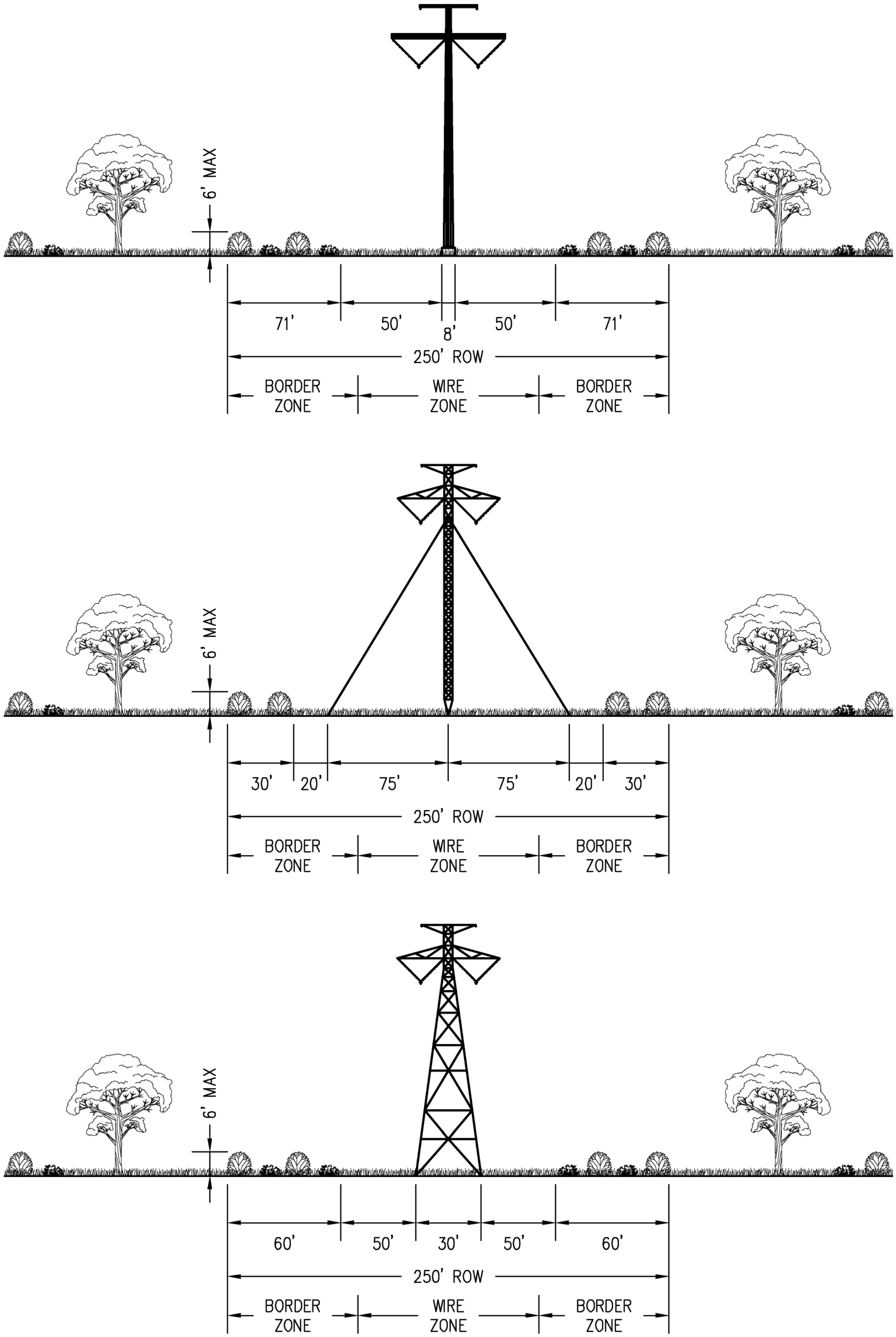

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FIGURE 21

LEVEL 1 STANDARD ROW VEGETATION MANAGEMENT – CROSS SECTION VIEW

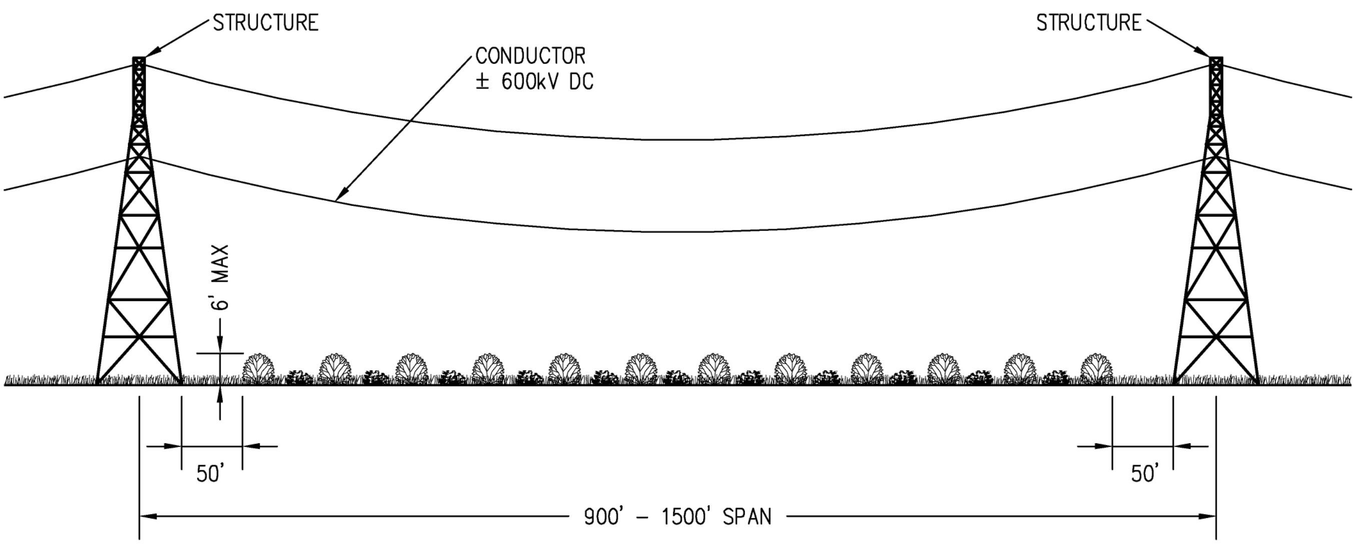

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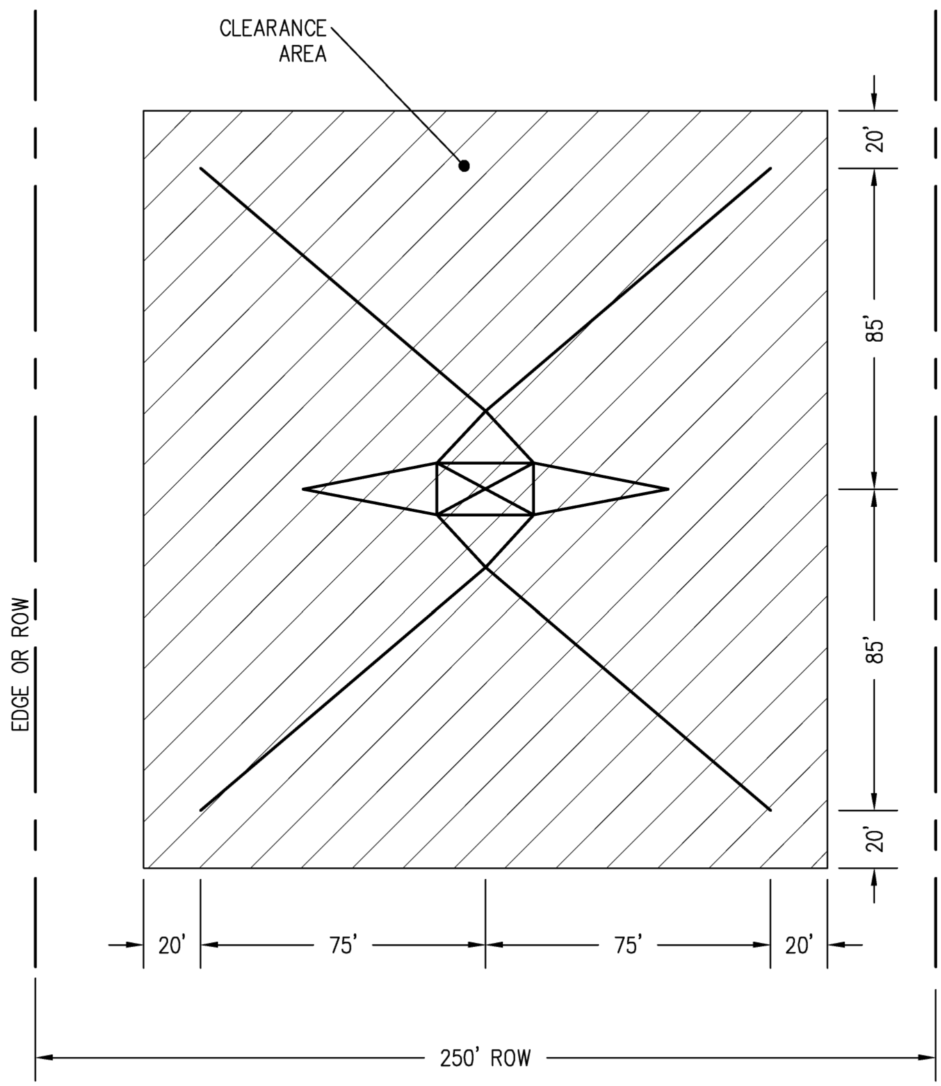
FIGURE 22

LEVEL 1 STANDARD ROW VEGETATION MANAGEMENT – PROFILE VIEW



CLEARANCE ZONE FOR GUYED LATTICE TOWER

(TYPICAL)

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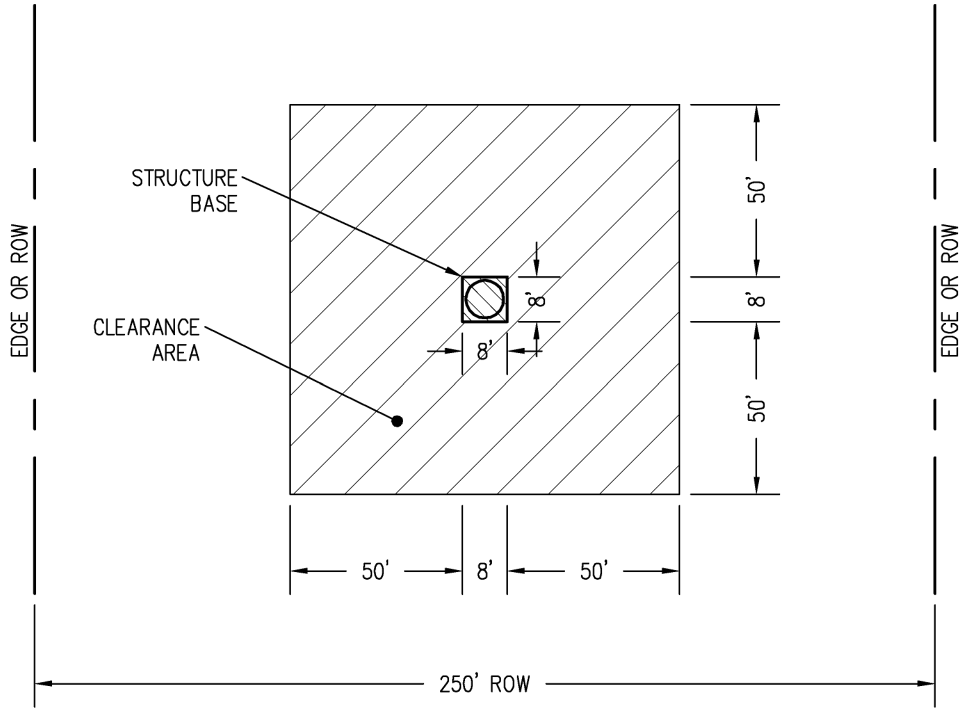
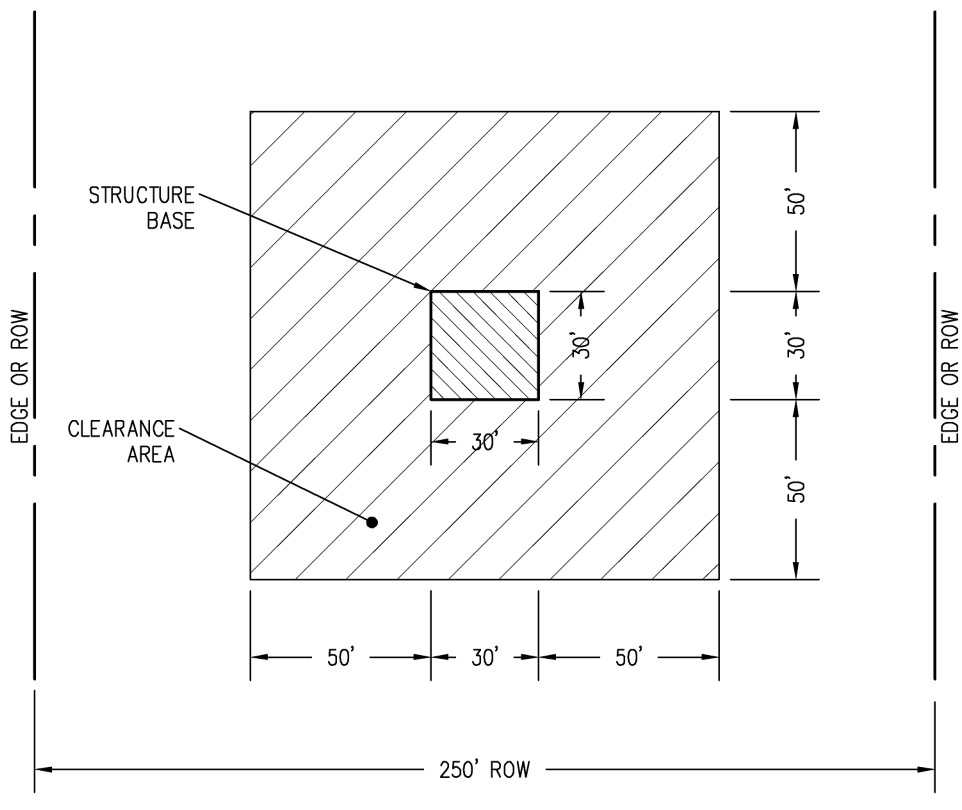
FIGURE 23

LEVELS 1, 2, & 3 VEGETATION CLEARANCE ZONE FOR GUYED STEEL LATTICE TOWER



CLEARANCE ZONE FOR TUBULAR STEEL POLE
(TYPICAL)



CLEARANCE ZONE FOR SELF-SUPPORTING LATTICE TOWER
(TYPICAL)

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FIGURE 24

LEVELS 1, 2, & 3 VEGETATION CLEARANCE ZONE FOR TUBULAR STEEL POLE & SELF SUPPORTING STEEL LATTICE TOWER

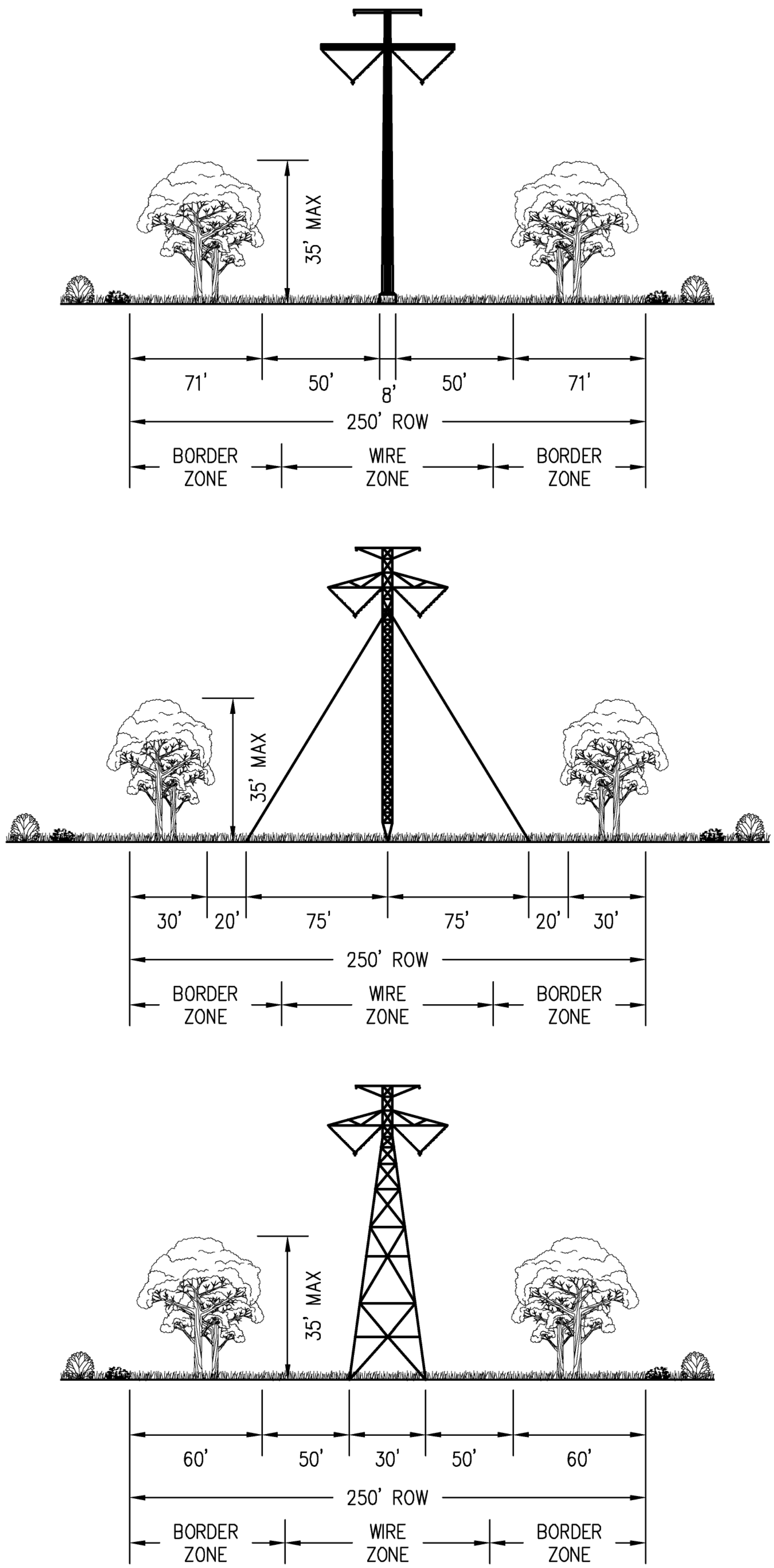

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FIGURE 25

LEVELS 2 & 3 SELECTIVE ROW VEGETATION MANAGEMENT – CROSS SECTION VIEW

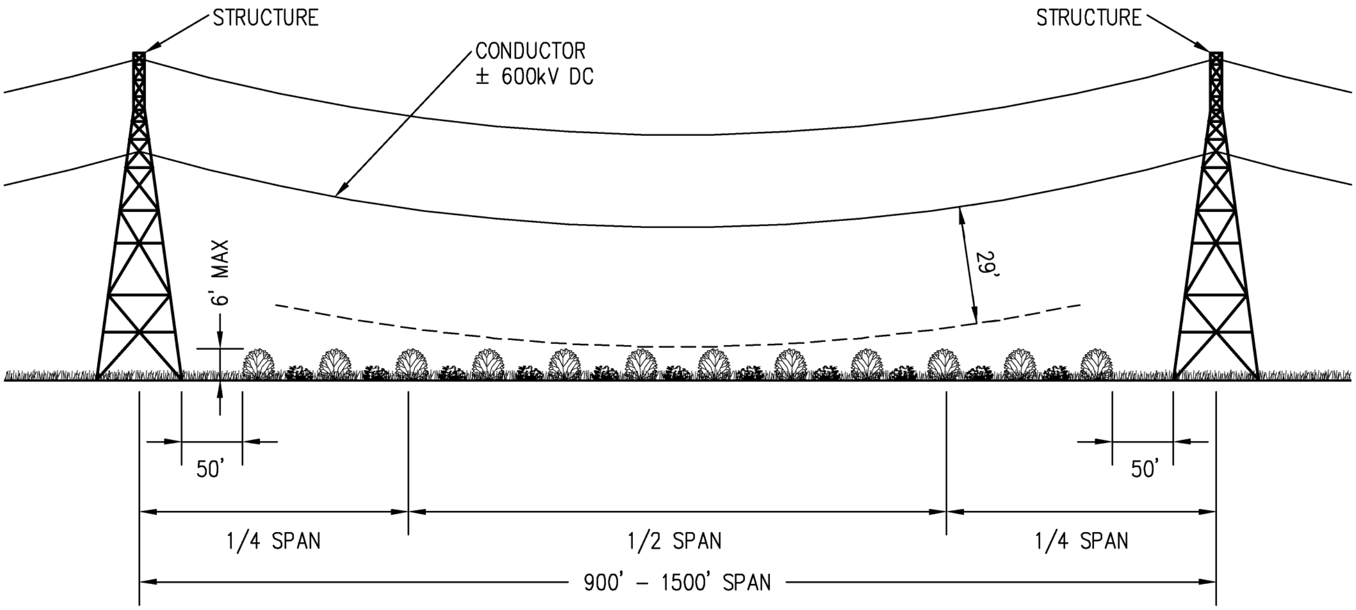
Border Zone. The Border Zone is defined as the section of the utility ROW that extends outward from Wire Zone boundary to the ROW boundary. For the TWE Project, the Border Zone would extend 80 feet on either side of the Wire Zone to the ROW boundary, depending on slope and other topographic conditions.

For Level 2, the desired condition within the Border Zone is to manage this section of the ROW for stable low-growth vegetation consisting of small trees and large shrubs, as well as lower grasses and herbs. The maximum vegetation height within the Border Zone, within the center half of the span is 25 feet. The maximum vegetation height within the Border Zone, within the quarter spans nearest the structures is 35 feet. Taller vegetation may also be suitable, depending on the growth and density characteristics of specific tree varieties, as well as increased height of the conductors across canyons or low-lying valleys. Figure 25 conceptually illustrates the differences in vegetation height that the Wire-Border Zone management technique would allow for each of the three structure types. Figures 26 and 27 illustrate a typical profile view of Level 2 vegetation heights.

Implementation. As part of construction, implementation standards for the clearing of the ROW and access roads would be the same in the Level 2 Wire Zone as described previously (refer to Level 1 discussion). Level 1 construction standards would also be applied to the Level 2 Border Zone in instances where undesirable vegetation needs to be removed and managed for the life of the Project (e.g., fast-growing or invasive species). Other techniques that may be used in the Level 2 Border Zone during construction are selective mechanical or manual tree removal, side pruning, and selective use of herbicides.

During operation, Level 2 vegetation would be managed the same as Level 1 in the Wire Zone. The Applicant would be responsible for routine inspections of vegetation. Annual plans for the inspection and treatment of vegetation would be implemented. The plan would describe the methods used, such as manual clearing, mechanical clearing, herbicide treatment, or other actions.

In the Border Zone, long-term operational practices would include additional techniques such as selective mechanical tree removal, selective manual control measures (e.g., use of hand-carried tools), and side pruning. Long-term operational management of ROW vegetation under Level 2 would be more costly and labor-intensive, over time, to ensure taller trees in the Border Zone do not violate NERC reliability standards for MVCD.



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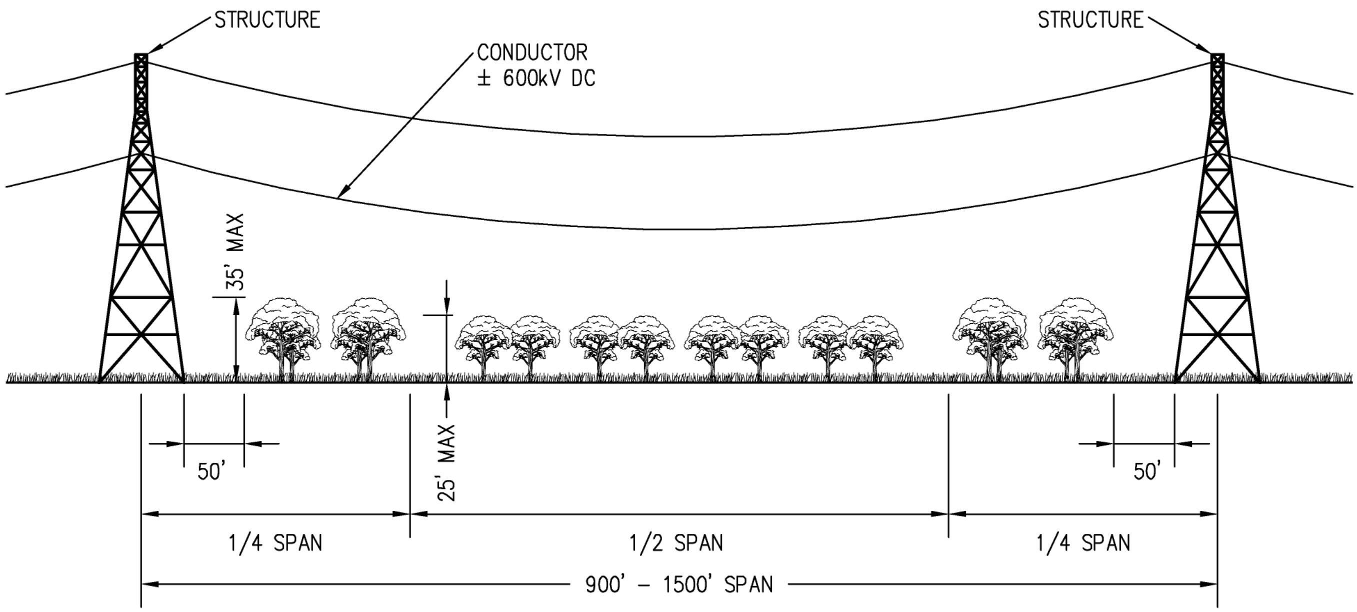
TRANSWEST EXPRESS TRANSMISSION PROJECT
FIGURE 26

LEVEL 2 SELECTIVE ROW VEGETATION MANAGEMENT – WIRE ZONE PROFILE VIEW



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TRANSWEST EXPRESS TRANSMISSION PROJECT
FIGURE 27

LEVELS 2 & 3 SELECTIVE ROW VEGETATION MANAGEMENT – BORDER ZONE PROFILE VIEW

Level 3 – Selective ROW Clearance-Based Vegetation Management

Application and Desired Condition. Level 3 is the Applicant's desired condition for limited and selective portions of the ROW that have been determined to have critical resource or agency management issues associated with vegetation within the Wire Zone. Level 3 vegetation management would meet the NERC standards, but would be significantly more costly in terms of on-going maintenance of the ROW, would require more frequent access to the ROW, and more frequent vegetation treatments. Consequently, Level 3 is proposed by the Applicant only in limited and specific areas of the ROW where practices would effectively mitigate potential impacts to critical resources and related land management issues. Examples of critically sensitive areas where Level 3 vegetation management may be appropriate are at ROW crossings of riparian vegetation or VRM Class II areas where potential impacts can be effectively mitigated with this vegetation management practice.

Level 3 builds on the Level 2 desired conditions described above. The desired condition for Level 3 is based on maintaining the Applicant-defined minimum clearance from energized conductors to any type of vegetation. Within the Wire Zone and Border Zone, the Level 3 desired condition would allow for increased vegetation diversity and heights, where such vegetation would not pose potential conflicts with the Applicant-defined minimum clearances to vegetation.

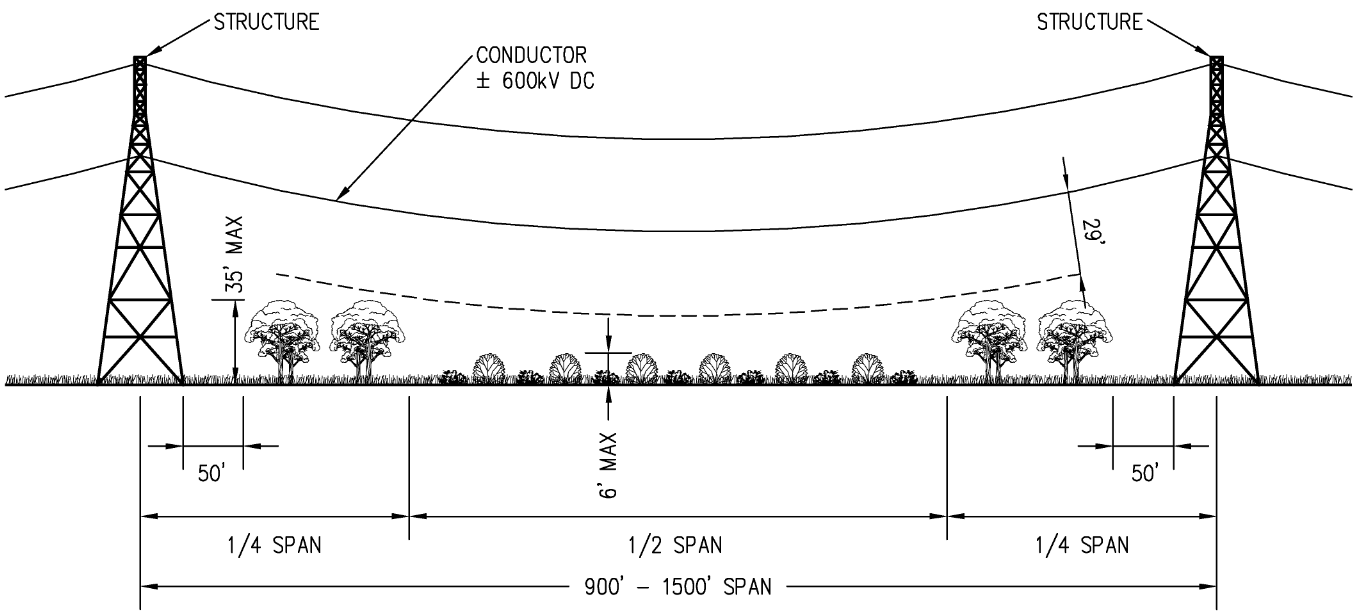
The Applicant-defined minimum clearances to vegetation have been established to incorporate NERC reliability standards, construction tolerances, conductor and tree movement due to wind and/or ice loading, increased sag as a result of thermal loading, and allowances for rapid vegetation growth. For the TWE Project, the minimum clearances from an energized conductor to vegetation would be:

- ±600 kV DC – 29 feet (at maximum elevation of 10,000 feet)
- 500 kV AC – 23 feet (at maximum elevation of 10,000 feet)

Under Level 3, increased vegetation heights anywhere within the ROW would be suitable where the vegetation does not encroach on the minimum clearance to vegetation established by the Applicant. Level 3 is also expected to be feasible at most ROW crossings of riparian vegetation due to increased structure heights at canyon crossings or low valley crossings. Level 3 vegetation management may also be achieved in some locations by increasing the height of structures at riparian crossings to allow a greater diversity and height of vegetation to remain.

For planning and determination of impacts purposes, the vegetation management for Level 3 should employ the Level 2 Border Zone definition described above. Figures 27 and 28 provide profiles for both the Wire and Border zones for Level 3.

Implementation. As part of construction, implementation standards for the clearing of the transmission structure sites and access roads within the ROW would be the same under Level 3 as previously described for Level 1 (refer to Level 1 discussion).



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TRANSWEST EXPRESS TRANSMISSION PROJECT
FIGURE 28

LEVEL 3 SELECTIVE ROW VEGETATION MANAGEMENT – WIRE ZONE PROFILE VIEW

In practice, Level 3 selective clearing of the entire ROW would be defined on a span-by-span basis such that any vegetation that does not meet the minimum clearance to vegetation established by the Applicant would be cleared. Level 3 construction standards would be applied in instances where undesirable vegetation needs to be removed from the ROW and managed for the life of the Project (e.g., fast-growing or invasive species). Selective clearing techniques that may be used for Level 3 clearance criteria during construction are selective mechanical tree removal, side pruning, and selective use of herbicides. In general, trees and larger shrubs would be retained through selective clearing.

During operation, Level 3 vegetation would be managed within the ROW to maintain the desired conditions. Long-term operational practices for Level 3 ROW areas would be more labor-intensive and expensive than Level 1 or 2, to ensure that, over time, taller trees and shrubs do not violate the Applicant-defined minimum clearances to vegetation. Level 3 also requires more frequent visitation and access to the ROW for inspections and vegetation treatments.

During operation, the Applicant would be responsible for routine inspections of vegetation. Annual plans for the inspection and treatment of vegetation would be implemented. The Plan would describe the methods to be used in Level 3 areas, as well as techniques applicable to the Level 1 and 2 portions of the ROW.

Appendix C summarizes how the TWE Project vegetation management program improvement levels would apply to each of the vegetation communities identified in AECOM's Memorandum, dated February 22, 2011 (AECOM 2011). Appendix C shows photographs of existing Western ROWs that characterize the Level 3 management vegetation strategies.

3.6.3 Terminals, Substation, Ground Electrodes and Communication Systems

Maintenance activities include equipment testing, equipment monitoring and repair, and emergency and routine procedures for service continuity and preventive maintenance. Terminal, substation, ground electrode and regeneration station monitoring and control functions are performed wholly or in part remotely from the Applicant's central operations facilities. Unauthorized entry into the terminal, substations or regeneration stations is prevented with the provision of fencing and locked gates. Warning signs would be posted and entry to the operating facilities would be restricted to authorized personnel.

Several forms of security are planned for each of the locations, although the security arrangements at each of the terminals, substations, ground electrode facilities, or regeneration stations may differ somewhat. Security measures may include fire detection in the control building via a monitoring system; alarming for forced entry; and a perimeter security system coupled with remote sensing infrared camera equipment in the fenced area of the station to provide visual observation/confirmation to the system operator of disturbances at the fence line.

Safety and security lighting at the terminals, substations and series compensation stations would be provided inside the fence for safety and security and for uncommon emergency night repair work. Dusk to dawn safety and security lighting will be used at the terminals and 500 kV AC substations.

Each of the terminals will have a control room staffed 24 hours per day, 365 days per year by two to three system operators and supervisory personnel. In addition to control room staffing, 8 to 20 technicians, engineers, maintenance, security, and supervisory personnel may be staffed at each terminal. Total staffing at each terminal is expected to be 20 to 30 people.

Routine maintenance for the terminal and adjacent substations would be performed by the on-site staff. Major inspection or maintenance activities would require additional personnel and equipment estimated to be 15 to 20 craft, technician, engineering, manufacturer, consultant and supervisory personnel for a period of two to four weeks on an estimated once per year basis.

For AC substations and series compensation stations located remote from the terminals it is anticipated that maintenance at each of these remote facilities would require approximately six trips per year by a two to four person crew. Routine operations would require two workers in a light utility truck to visit the remote substation or series compensation station monthly. Typically, once per year a major inspection or maintenance effort may be required which would require up to 15 personnel for one to three weeks. If substation landscaping is required by the permitting agency, drought-tolerant plant materials would be used to minimize watering requirements after plant establishment.

Communication regeneration stations would be visited every two to three months by two individuals in a light truck to inspect the facilities. Annual maintenance would be performed by a two-man crew in a light truck over a two to five day period.

Ground electrode facilities would be visited every two to three months by two individuals in a light truck to inspect the facilities. Annual maintenance would be performed by a two man crew in a light truck over a two to five day period. The ground electrode connector line would be inspected by aerial and ground based inspection identical to the maintenance program described for the transmission lines.

3.6.3.1 Water Use

Operation and maintenance of the Northern and Southern Terminals is expected to require water use by personnel in the Operations and Maintenance office building and by the HVDC evaporative cooling and misting systems during summer months. Monthly and annual estimated water use is provided in Table 8.

TABLE 8 NORTHERN AND SOUTHERN TERMINAL ANNUAL ESTIMATED WATER USE (ALL VALUES IN ACRE-FEET)

MONTH	OFFICE USE	COOLING & MISTING SYSTEMS FOR N. TERMINAL	COOLING & MISTING SYSTEMS FOR S. TERMINAL	TOTAL USE N. TERMINAL	TOTAL USE S. TERMINAL
January	0.069	0	0	0.069	0.069
February	0.062	0	0	0.062	0.062
March	0.069	0	0	0.069	0.069
April	0.066	0	0	0.066	0.066
May	0.069	0	0.034	0.069	0.103
June	0.066	0.068	0.068	0.134	0.134
July	0.069	0.135	0.135	0.205	0.205
August	0.069	0.068	0.135	0.137	0.204
September	0.066	0	0.068	0.066	0.134
October	0.069	0	0	0.069	0.069

TABLE 8 NORTHERN AND SOUTHERN TERMINAL ANNUAL ESTIMATED WATER USE (ALL VALUES IN ACRE-FEET)

MONTH	OFFICE USE	COOLING & MISTING SYSTEMS FOR N. TERMINAL	COOLING & MISTING SYSTEMS FOR S. TERMINAL	TOTAL USE N. TERMINAL	TOTAL USE S. TERMINAL
November	0.066	0	0	0.066	0.066
December	0.069	0	0	0.069	0.069
Annual	0.809	0.272	0.44	1.081	1.25

Source: BBA 2012

Annual office use of water for each terminal is estimated at 0.809 acre-feet. The office building will consist of approximately 7,200 square feet of actively used space including offices, kitchen, and bathrooms with a shower. The annual office water use was conservatively estimated based upon this actively used square footage and a water use estimate of 0.75 acre-feet per year per 6,695 square feet of office space (Douglas County 1999).

Evaporative cooling will not likely be needed for ambient air temperatures up to 104° Fahrenheit (40° Celsius). If ambient air temperatures exceed 113° Fahrenheit (45° Celsius), then misting and evaporative cooling will be required for these short time periods.

Annual water use for HVDC evaporative cooling and misting systems at the Northern Terminal is estimated at 0.272 acre-feet. Use includes 400 gallons per year for maintenance and flushing of the cooling system and an estimated 88,000 gallons per year for the misting system. The misting system use was estimated to at 275 gallons per hour, running eight hours per day for 10 days in June, 20 days in July, and 10 days in August for a total of 40 days. Evaporative cooling of the filters is not anticipated.

Annual water use for HVDC evaporative cooling and misting systems at the Southern Terminal is estimated at 0.440 acre-feet. Use includes 400 gallons per year for maintenance and flushing of the cooling system and an estimated 143,000 gallons per year for the misting system. The misting system use was estimated to at 275 gallons per hour, running eight hours per day for 5 days in May, 10 days in June, 20 days in July, 20 days in August and 10 days in September for a total of 65 days. Evaporative cooling of the filters is not anticipated.

The water use for each of the terminals may vary from these estimates based on the cooling system technology employed for the terminals. Non-evaporative cooling technologies are available and will be considered during the detailed engineering for the terminal equipment.

3.6.4 Emergency Response

The operation of the system is managed and monitored from control rooms at each of the terminals and at Applicant's operation center. Electrical outages or variations from normal operating protocols would be sensed and reported at these operation centers. The remote substations and series compensation stations are equipped with remote monitoring, proximity alarms, and in some cases, video surveillance with monitoring and control functions performed at the control rooms at the terminals and/or at the Applicant's operation center.

The implementation of routine operation and maintenance activities on power lines minimize the need for most emergency repairs. Emergency maintenance activities are often those activities necessary to repair natural hazard, fire, or human-caused damages to a line. Such work is required to eliminate a safety hazard, prevent imminent damage to the power line, or restore service if there is an outage. In an emergency, the Applicant must respond as quickly as possible to restore power.

In most cases, the equipment necessary to carry out emergency repairs is similar to that necessary to conduct routine maintenance. More extensive emergency repair may also require the same types of equipment used during construction, including hole drilling equipment, backhoes for excavation, and/or concrete trucks and cranes for structure erection. Other required equipment may include power tensioners, pullers, wire trailers, crawler tractors, and trucks and pickups for hauling materials, tools, and workers. Under certain conditions, a helicopter may be used to haul in material and erect towers or string conductor in those areas where access and/or terrain conditions preclude the use of conventional methods. Site and access road disturbances, such as ruts created during emergency operations, will be restored to satisfactory condition using restoration and rehabilitation procedures.

In the event of an emergency, crews will be dispatched quickly to repair or replace any damaged equipment. Every attempt will be made to contact the agency or landowners along the ROW. In the event notification cannot be made, repair operations will proceed only in the case of an emergency situation. Repair of the line will have priority under emergency conditions, and reasonable efforts will be made to protect plants, wildlife, and other resources. Restoration and rehabilitation procedures following completion of repair work will be similar to those prescribed during construction.

Emergency response procedures will be implemented for the following potential events:

- Downed transmission lines, structures, or equipment failure
- Fires
- Sudden loss of power
- Natural disasters
- Serious personal injury

3.6.5 Fire Protection

All federal, state, and county laws, ordinances, rules, and regulations pertaining to fire prevention and suppression would be strictly adhered to. All personnel would be advised of their responsibilities under the applicable fire laws and regulations.

When working on public or National Forest System lands, the Applicant's employees and Contractors would be equipped with approved suppression tools and equipment. The Applicant or its Contractor would notify local fire authorities and the BLM or USFS (as appropriate) if a Project-related fire occurs within or adjacent to a construction area.

If the Applicant becomes aware of an emergency situation that is caused by a fire on or threatening BLM-managed or USFS lands and that could damage the transmission lines or their operation, it would notify the appropriate agency contact. Specific construction-related activities and safety measures would be implemented during construction of the transmission line to prevent fires and to ensure quick response and suppression if a fire occurs. Typical practices to prevent fires during construction and maintenance/repair activities include brush-clearing prior to work, stationing a water truck at the job site to keep the ground and vegetation moist in extreme fire conditions, enforcing red flag warnings, providing "fire behavior" training to all pertinent personnel, keeping vehicles on or within designated roads or work areas, and providing fire suppression equipment and emergency notification numbers at each construction site.

3.6.6 ROW Safety Requirements

The design, operation, and maintenance of the TWE Project will meet or exceed applicable criteria and requirements outlined by the FERC, WECC, NESC, and U.S. Department of Labor Occupational Safety and Health Standards for the safety and protection of landowners, their property, and the general public. The transmission line will be protected with power circuit breakers and line relay protection equipment. If a conductor or component failure occurs, power will be automatically removed from the line. Lightning protection will be provided by overhead shield wires on the top of the line. Where vegetation presents a potential hazard, trees will be trimmed or cut to prevent accidental grounding contact with conductors.

3.6.7 Building and Fence Grounding

As part of the proposed TWE Project, short distances (five miles or less) of AC transmission lines will be constructed between the TWE Project substations and the existing and planned regional AC transmission system. In order to mitigate possible electric shock caused by electrostatic and electromagnetic AC induction, all buildings, fences, and other structures with metal surfaces located within 300 feet of the centerline of the ROW will be grounded to the mutual satisfaction of the parties involved. Typically, residential buildings located 300 feet from the centerline will not require grounding. Other buildings or structures outside of the ROW will be reviewed in accordance with the NESC to determine grounding requirements. All metal irrigation systems and fences that parallel the transmission line for distances of 500 feet or more, within 300 feet of the centerline will be grounded. All fences that cross under the transmission line also will be grounded. This procedure will be included in the construction specifications, and if grounding is required outside the ROW, agency and landowner consent will be obtained as necessary.

3.6.8 Decommissioning Practices

The proposed transmission line would have a projected operational life of at least 50 years or longer. At the end of the useful life of the Project and if the facility were no longer required, the transmission line would be removed from service. At such time, conductors, insulators, and hardware would be dismantled and removed from the ROW. Structures would be removed and foundations removed to below-ground surface.

Following abandonment and removal of the transmission line structures and equipment from the ROW, any areas disturbed during line dismantling would be restored and rehabilitated. In the same way, if a terminal, substation, or regeneration station is no longer required, the buildings, structures and equipment would be dismantled and removed from the site. The station structures would be disassembled and either re-used at another station or sold for scrap. Major equipment such as breakers, transformers, and reactors would be removed, refurbished, and stored for use at another facility. Foundations would be either abandoned in-place or cut off below ground level and buried.

For access roads serving the transmission line, the Applicant is responsible for the decommissioning and reclamation of access roads following abandonment in accordance with the landowner's or land agency's direction.

3.7 TWE Project Environmental Mitigation Measures

Prior to construction, the Applicant will prepare a COM Plan, which will incorporate environmental measures, stipulated in the Lead Agencies' Records of Decision(s) (RODs). The COM Plan will provide information on the TWE Project design, construction, operation, and maintenance practices, and environmental mitigation measures that will be used and implemented by contractors and personnel.

The following is a preliminary list of specific plans, which will be incorporated into the COM Plan:

- Access Road Plan
- Biological Protection Plan
- Blasting Plan
- Clean-up Work Management Plan
- Cultural Resources Treatment Plan
- Erosion, Dust Control and Air Quality Plans
- Fire Protection Plan
- Flagging, Fencing and Signage Plan
- Hazardous Materials Management Plan
- Health and Safety Plan
- Mitigation Monitoring Plan
- Noxious Weed Management Plan
- Paleontological Resources Management and Mitigation Plan
- Pesticide Use Plan
- ROW Preparation, Rehabilitation, and Restoration Plan
- Spill Prevention Notification and Clean Up Plan
- Storm Water Pollution Prevention Plan
- Vegetation Management Plan
- Wetlands and Waters of the U.S. Mitigation Plan (CWA, Section 404 Permit)

The COM Plan will include the TWE Project-committed mitigation measures. Mitigation measures include general mitigation measures, which would apply to the TWE Project as a whole; and selective mitigation measures, which would be implemented on a case-by-case basis to address specific environmental impacts or localized conditions. The mitigation measures will be updated through the NEPA process to incorporate appropriate selective mitigation measures.

Table 9 identifies the general mitigation measures, which will be used to reduce impacts to environmental resources. Mitigation measures are organized by major resource topics. These measures are part of the proposed TWE Project, and would be common to all the DEIS alternatives. Table 9 identifies the phase(s) during which each measure would be implemented:

- P – planning and engineering design
- C – construction
- O – operation and maintenance

TABLE 9	TWE PROJECT COMMITTED ENVIRONMENTAL MITIGATION MEASURES		
NO.	PHASE(S)	TOPIC	DESCRIPTION OF MITIGATION MEASURE
			GENERAL MEASURES
1	P	General, compliance with agency stipulations and RODs	The TWE Project will be planned, constructed, operated, and decommissioned in accordance with the agencies' Records of Decision (RODs), the BLM's ROW Grant stipulations, USFS Special Use Permit stipulations, and requirements of other permitting agencies.
2	P	General, compliance with laws and regulations	The Applicant will comply with all applicable environmental laws and regulations. Applicable laws and regulations may include, but are not limited to, the Clean Water Act (CWA) Section 303(d) and Section 404; the Wild and Scenic Rivers Act, Section 3(a) or 2(a) ii; the Endangered Species Act (ESA), Section 7; the National Historic Preservation Act (NHPA), Section 106; and the Native American Graves Protection and Repatriation Act (NAGPRA). Compliance with all applicable laws and regulations will be documented in the Final POD/COM Plan.
3	P	General, mitigation monitoring plan	The COM Plan will include a mitigation monitoring plan that will address how each mitigation measure, required by permitting agencies in their respective decision documents and permits will be monitored for compliance.
4	P	General, environmental training	Prior to construction, all personnel will be instructed on the protection of cultural, paleontological, ecological resources, and other natural resources in accordance with the COM Plan provisions. To assist in this effort, the construction contract would address (a) federal, state, and tribal laws regarding cultural resources, fossils, plants, and wildlife, including collection and removal; and (b) the importance of these resources and the purpose and necessity of protecting them.
			PROJECT DESIGN, ACCESS AND CONSTRUCTION
5	P	General, compliance with laws and regulations	The COM Plan will display the location of Project infrastructure (i.e. towers, access roads, substations) and identify short-term and long-term land and resource impacts and the mitigation measures that will be implemented for site-specific and resource-specific environmental impacts.
6	P	General, Access Road Plan	The COM Plan will include an Access Road Plan that incorporates relevant agency standards regarding road design, construction, maintenance, and decommissioning. The Access Road Plan will incorporate best management practices, stipulated by the agencies in their respective decision documents and permits.
7	P	Access, visual	The alignment of any new access roads will follow the designated area's landform contours where practical, providing that such alignment does not additionally impact resource values. This will minimize ground disturbance and reduce scarring (visual contrast).
8	P, C	Access, tower placements, surface water, vegetation management, drainage, dust control	Crossings of streams and waterways will be done in compliance with federal, state, and local regulations. Roads will be built as near as possible at right angles to the streams and washes (Arizona crossing). Culverts will be installed where necessary. All construction and maintenance activities will be conducted in a manner that will minimize disturbance to vegetation, drainage channels, and intermittent or perennial stream banks. In addition, road construction will include dust-control measures during construction in sensitive areas. All existing roads will be left in a condition equal to, or better than, their condition prior to the construction of the transmission line. Structures will be sited with a minimum distance of 200 feet from streams,

TABLE 9	TWE PROJECT COMMITTED ENVIRONMENTAL MITIGATION MEASURES		
NO.	PHASE(S)	TOPIC	DESCRIPTION OF MITIGATION MEASURE
			wherever possible.
9	C, O	Access	All construction vehicle movement outside the ROW normally will be restricted to pre-designated access or public roads.
10	P, C	General ROW, visual	The area limits of construction activities will normally be predetermined, with activity restricted to and confined within those limits. No paint or permanent discoloring agents will be applied to rocks or vegetation to indicate survey or construction activity limits.
11	P, C	Access, visual	In construction areas where re-contouring is not required, vegetation will be left in place, wherever possible, and original contour will be maintained to avoid excessive root damage and to allow for re-sprouting.
12	P, C, O	Access, soils, vegetation, water, cultural visual resources	Except for repairs necessary to make roads passable, no widening or upgrading of existing access roads will be undertaken in the area of construction and operation, where soils or vegetation are sensitive to disturbance. In designated areas, structures will be placed to avoid sensitive features such as, but not limited to, riparian areas, water courses and cultural sites, or to allow conductors to clearly span the features within limits of standard structure design. This will minimize the amount of disturbance to the sensitive feature or reduce visual contrast.
13	C	Vegetation management, restoration, erosion control	In construction areas (e.g., marshalling yards, structure sites, spur roads from existing access roads) where ground disturbance is significant or where re-contouring is required, surface restoration will occur as required by the landowner or land management agency. The method of restoration will normally consist of returning disturbed areas back to their natural contour, reseeding (if required), installing cross drains for erosion control, placing water bars in the road, and filling ditches.
14	P, C	General, soils, erosion control, visual	The COM Plan will show the location of borrow sites, from which material will be obtained. Borrow pits will be stripped of topsoil to a depth of approximately six inches. Stripped topsoil will be stockpiled and, upon completion of borrow excavation, spread to a uniform depth of six inches over areas of borrow pits from which removed. Before replacing topsoil, excavated surfaces will be reasonably smooth and uniformly sloped. The sides of borrow pits will be brought to stable slopes with slope intersection shaped to carry the natural contour of adjacent undisturbed terrain into the pit to give a natural appearance. When necessary, borrow pits will be drained by open ditches to prevent accumulation of standing water.
15	C	Clean-up	The COM Plan will include a Clean-up Work Management Plan, and a Flagging, Fencing, and Signage Plan. Except for permanent survey markers, and material that locate proposed facilities, stakes, pins, rebar, spikes, and other material will be removed from the surface and within the top 15 inches of the topsoil as a part of final clean-up. Fences on ROW will be removed where necessary and replaced to the original condition or better when the work is finished. Where existing fences are removed to facilitate the work, temporary fence protection for lands adjacent to the ROW will be provided at all times during the continuation of the Contract. Such temporary fence protection will be adequate to prevent public access to restricted areas. Temporary fencing constructed on the ROW will be removed by the Contractor as part of the clean-up operations prior to final acceptance of the completed work.

TABLE 9 TWE PROJECT COMMITTED ENVIRONMENTAL MITIGATION MEASURES			
NO.	PHASE(S)	TOPIC	DESCRIPTION OF MITIGATION MEASURE
16	C	Site restoration and clean-up, water resources, land use	Watering facilities (tanks, natural springs and/or developed springs, water lines, wells, etc.) will be repaired or replaced, if damaged or destroyed by construction activities, to their pre-disturbed condition as required by the landowner or land management agency.
17	C	Site restoration and clean-up	Existing vegetation such as landscape plants, gardens, and field crops, which are damaged by the application of the soil-applied herbicide, will be replaced by the Contractor at its expense.
18	C	Site clean-up	The Applicant will pay fair market value to the land management agency for any merchantable forest products that will be cut during ROW clearing. Merchantable forest products will either be removed or stacked at locations determined by the land management agency.
GEOLOGY AND SOILS			
19	C	Drainage, soil erosion control	The COM Plan will include an Erosion Control Plan. Grading will be performed to provide adequate drainage around structure sites and sufficient clearance under conductors. Excavated material will be spread around the site from which excavated. Topsoil will be piled separately and replaced after work completion.
GROUNDWATER, SURFACE WATER AND WETLANDS			
20	P	Water quality	As part of the CWA 404 Permit for the TWE Project, the COM Plan will include a Wetlands and Waters of the U.S. Plan, which will incorporate measures to avoid and minimize impacts to wetlands and waters of the U.S. to the extent practical. The COM Plan will include a Storm Water Pollution Prevention Plan. The Applicant will identify all streams in the vicinity of the proposed project sites that are listed as impaired under Section 303(d) of the CWA and develop a management plan to avoid, reduce, and/or minimize adverse impacts to those streams.
21	P	Water quality	The Applicant will obtain a National Pollutant Discharge Elimination System (NPDES) permit from the Environmental Protection Agency (EPA) prior to construction.
22	C	Water quality	Runoff from excavated areas, construction materials or wastes (including truck washing and concrete washes), and chemical products such as oil, grease, solvents, fuels, and pesticides will be controlled. Excavated material or other construction material will not be stockpiled or deposited near or on stream banks, lake shorelines, ditches, irrigation canals, or other areas where runoff could impact the environment.
23	C	Water quality	Washing of concrete trucks or disposal of excess concrete in any ditch, canal, stream, or other surface water will not be permitted. Concrete wastes will be disposed of in accordance with all federal, state and local regulations.
24	C, O	Surface water, wetlands	Vehicle refueling and servicing activities will be performed in designated construction zones located more than 100 feet from wetlands and streams. Spill prevention and containment measures or practices will be incorporated as needed.
25	P	Dewatering	A dewatering permit will be obtained from the appropriate agencies if required for construction dewatering activities.
VEGETATION AND SOILS MANAGEMENT			
26	P, C	Vegetation management and noxious weeds	The COM Plan will include a Vegetation Management Plan and a Noxious Weed Management Plan. The Vegetation Management Plan will address plant removal and selective clearing. The Noxious Weed Management Plan

TABLE 9	TWE PROJECT COMMITTED ENVIRONMENTAL MITIGATION MEASURES		
NO.	PHASE(S)	TOPIC	DESCRIPTION OF MITIGATION MEASURE
			will be developed in accordance with appropriate land management agencies' standards, consistent with applicable regulations and agency permitting stipulations for the control of noxious weeds and invasive species (Executive Order (E.O.) 13112). Included in the Noxious Weed Management Plan will be stipulations regarding construction, restoration, and operation (use of weed-free materials, washing of equipment, etc.).
27	C	Vegetation management	In construction areas where re-contouring is not required, vegetation will be left in place wherever possible and original contour will be maintained to avoid excessive root damage and allow for re-sprouting.
28	C	Vegetation management, visual	Clearing will be performed so as to minimize marring and scarring the countryside and preserve the natural beauty to the maximum extent possible. Except for danger trees, no clearing will be performed outside the limits of the ROW.
			ECOLOGICAL RESOURCES
29	P, C	Ecological, special status species	The COM Plan will include a Biological Protection Plan, which will identify important, sensitive, or unique habitats and BLM sensitive, USFS sensitive, and state-listed species in the vicinity of the TWE Project. The COM Plan will identify measures to be taken to avoid, minimize, or mitigate impacts to these habitats and species.
30	P	Ecological, raptors	In applicable areas, the TWE Project will be designed to meet or exceed the raptor safe design standards described in the *Suggested Practices for Avian Protection on Power Lines: The State of the Art in 2006* (Avian Power Line Interaction Committee (APLIC) 2006).
31	P, C, O	Ecological, special status species	Mitigation measures that will be developed during the consultation period with the BLM and under Section 7 of the ESA will be adhered to, along with mitigation developed in conjunction with state authorities.
32	P, C	Ecological, special status species	Seasonal restrictions may be implemented in certain areas to mitigate impacts on wildlife. With the exception of emergency repair situations, ROW construction, restoration, maintenance, and termination activities in designated areas will be modified or discontinued during sensitive periods (e.g., nesting and breeding periods) for candidate, proposed or listed threatened and endangered, or other sensitive animal species, as required by permitting agencies. Potential seasonal restrictions and avoidance buffers for nesting raptors will be identified in the DEIS. The Biological Protection Plan will incorporate the seasonal restrictions and stipulations contained in the federal agency RODs.
33	P, C	Ecological, special status species and habitats	Prior to the start of construction, the Applicant will provide training to all Contractor and Subcontractor personnel and others involved in construction activities where/if there is a known occurrence of protected species or habitat in the construction area. Sensitive areas will be considered avoidance areas. Prior to any construction activity, avoidance areas will be marked on the ground and maintained through the duration of the Contract. The Applicant will remove markings during or following final inspection of the Project.
34	C	Ecological, special status species and habitats	If evidence of a protected species not previously identified or known is found in the Project area, the Contractor will immediately notify the appropriate land management agencies and provide the location and nature of the findings.
			CULTURAL RESOURCES – HISTORIC, ARCHAEOLOGICAL, AND TRIBAL TRADITIONAL

TABLE 9	TWE PROJECT COMMITTED ENVIRONMENTAL MITIGATION MEASURES		
NO.	PHASE(S)	TOPIC	DESCRIPTION OF MITIGATION MEASURE
35	P, C	Cultural resources	In consultation with the appropriate land management agencies and state historic preservation officers (SHPOs), and in accordance with the Programmatic Agreement (PA), a Cultural Resources Treatment Plan will be prepared as part of the COM Plan to address the specific mitigation measures for cultural resources that will be developed and implemented to mitigate any identified adverse effects. These may include Project modifications to avoid adverse impacts, monitoring of construction activities, and data recovery studies.
36	P, C	Native American cultural resources	The Applicant will comply with all laws, policies, and regulations pertaining to consultations with federally recognized Tribes.
37	P	General, cultural	Prior to construction, all construction personnel will be instructed on the protection of cultural resources, including the provisions of federal, state, and tribal laws regarding cultural resources, including prohibition of collection and removal; and the importance of these resources and the purpose and necessity of protecting them.
			PALEONTOLOGICAL RESOURCES
38	P, C, O	Paleontology	If paleontological resources are known to be present in the Project area, or if areas with a high potential to contain paleontological material has been identified through the NEPA process and DEIS, the Applicant will prepare a Paleontological Resources Management and Mitigation Plan as part of the COM Plan.
39	P	Paleontology	Paleontological mitigation may be required in areas of greatest disturbance and areas likely to have significant fossils. Preconstruction surveys of such areas may be conducted as agreed upon by the land-managing and lead federal agency.
			LAND USE AND VISUAL RESOURCES
40	P, C, O	Land Use, agriculture	On agricultural land, the ROW will be aligned, in so far as practical, to reduce the impacts to farm operations and agricultural production.
41	C	Land Use, agriculture	In cultivated agricultural areas, soil compaction by construction activities will be disked to uncompacted soils. Construction activities will minimize impacts on agricultural operations.
42	C	Land Use, ranching	In grazing areas, excessive amounts of pine needles left by clearing of trees, will be removed from the ROW and disposed of in a location to prevent harm to grazing domestic animals.
43	C	Access, land use, gates	The COM Plan will include a Flagging, Fencing, and Signage Plan. Fences and gates will be repaired or replaced to their original pre-disturbed condition as required by the landowner or the land management agency if they are damaged or destroyed by construction activities. Temporary gates will be installed only with the permission of the landowner or the land management agency, and will be restored to their original pre-disturbed condition following construction. Cattle guards will be installed where new permanent access roads cut through fences, at the request of the land management agency.
44	P, C, O	Visual	Non-specular conductors and shield/ground wires will be used to reduce potential visual impacts.
45	P, C, O	Structure design and public safety	Structures and/or shield/ground wire will be marked with high-visibility devices where required by governmental agencies (Federal Aviation Administration (FAA)). Structure heights will be less than 200 feet, where feasible, to minimize the need for aircraft obstruction lighting.

TABLE 9	TWE PROJECT COMMITTED ENVIRONMENTAL MITIGATION MEASURES		
NO.	PHASE(S)	TOPIC	DESCRIPTION OF MITIGATION MEASURE
46	P, C, O	Visual resources	The Applicant will comply with federal permitting agency stipulations regarding visual resources.
		AIR QUALITY	
47	P, C	Air quality, dust control	The COM Plan will include a Dust Control and Air Quality Plan. Requirements of those entities having jurisdiction over air quality matters will be adhered to and dust control measures will be developed. Open burning of construction trash will not be allowed unless permitted by appropriate authorities.
48	P, C	Air quality, emissions	The Contractor and Subcontractor(s) will be required to have and use air emissions control devices on construction machinery, as required by federal, state or local regulations or ordinances.
		CORONA EFFECTS	
49	P, C, O	Corona	Transmission line materials will be designed to minimize corona. The proposed hardware and conductor will limit the audible noise, radio interference, and TV interference due to corona. Tension will be maintained on all insulator assemblies to assure positive contact between insulators, thereby avoiding sparking. Caution will be exercised during construction to avoid scratching or nicking the conductor surface that may provide points for corona to occur.
50	O	TV, radio interference	The Applicant will respond to complaints of line-generated radio or television interference by investigating the complaints and implementing appropriate mitigation measures. The transmission line will be patrolled on a regular basis so that damaged insulators or other line materials that could cause interference are repaired or replaced.
		PUBLIC HEALTH AND SAFETY	
51	P, C, O	Safety standards	The TWE Project will be designed, constructed, and operated to meet or exceed the requirements of the National Electrical Safety Code (NESC), U.S. Department of Labor, Occupational Safety and Health Administration standards, and the Applicant's requirements for safety and protection of landowners and their property.
52	O	Induced currents	The Applicant will apply necessary mitigation to eliminate problems of induced currents and voltages onto conductive objects sharing ROW, to the mutual satisfaction of the parties involved.
53	P, C	Blasting	The COM Plan will include a Blasting Plan, which will identify methods and mitigation measures to minimize the effects of blasting, where applicable. The Blasting Plan will document the proposed methods to achieve the desired excavations, proposed methods for blasting warning, use of non-electrical blasting systems, and provisions for controlling fly rock, vibrations, and air blast damage.
54	P, C, O	Noise, electrostatic, and EMF	Research studies performed to determine the effects of audible noise and electrostatic and electromagnetic fields (EMF) will be regularly monitored by the Applicant to ascertain whether these effects are significant.
55	P, C, O	FAA regulations	The TWE Project will be designed to comply with FAA regulations, including lighting regulations, to avoid potential safety issues associated with proximity to airports, military bases or training areas, or landing strips.
56	P	Worker health and safety	As part of the COM Plan, the Applicant will provide a Health and Safety Plan, which will outline measures to protect workers and the general public during construction, operation, and decommissioning of the TWE Project. The Plan will identify applicable federal and state occupational safety standards,

TABLE 9	TWE PROJECT COMMITTED ENVIRONMENTAL MITIGATION MEASURES		
NO.	PHASE(S)	TOPIC	DESCRIPTION OF MITIGATION MEASURE
			establish safe work practices, and define safety performance standards.
		HAZARDOUS MATERIALS, WASTE, AND WASTEWATER MANAGEMENT	
57	P	Hazardous materials	As part of the COM Plan, the Applicant will provide a Spill Prevention Notification and Clean-up Plan. The Plan will address compliance with all applicable federal, state, and local regulations, and will include: spill prevention measures, notification procedures in the event of a spill, employee awareness training, and commitment of manpower, equipment, and materials to respond to spills, if they occur.
58	P	Hazardous materials	As part of the COM Plan, the Applicant will provide a Pesticide Use Plan. The Plan will address compliance with all applicable federal, state and local regulations.
59	P	Hazardous materials	As part of the COM Plan, the Applicant will provide a Clean-up Work Management Plan that has been approved by applicable federal, state or local environmental regulation agencies. The plan will address on-site excavation of contaminated soils and debris and will include: identification of contaminants, methods of excavation, personnel training, safety and health procedures, sampling requirements, management of excavated soils and debris, and disposal methods.
60	C	Waste management	No non-biodegradable debris will be deposited in the ROW. Slash and other biodegradable debris will be left in place or disposed of in accordance with agency requirements.
61	C, O	Hazardous materials, waste management	As part of the COM Plan, the Applicant will provide a Hazardous Materials Management Plan. Hazardous materials will not be drained onto the ground or drainage areas. Totally enclosed containment will be provided for all trash. All construction waste including trash and litter, garbage, other solid waste, petroleum products, and other potentially hazardous materials will be removed to a disposal facility authorized to accept such materials.
62	C, O	Hazardous materials	If a reportable release of hazardous substance occurs at the work site, the Contractor will immediately notify the Applicant and all environmental agencies, as required by law. The Contractor will be responsible for the clean-up.
		FIRE PROTECTION	
64	P, C	Fire, safety	The COM Plan will include a Fire Protection Plan. The Applicant or its Contractor(s) will notify the BLM of any fires and comply with all rules and regulations administered by the BLM and USFS concerning the use, prevention, and suppression of fires on federal lands, including any fire prevention orders that may be in effect at the time of the permitted activity. The Applicant or its Contractor(s) may be held liable for the cost of fire suppression, stabilization, and rehabilitation. In the event of a fire, personal safety will be the first priority of the Applicant or its Contractor(s). The Applicant or its Contractor(s) will: • Operate all internal and external combustion engines on federally-managed lands per 36 CFR 261.52(j), which requires all such engines to be equipped with a qualified spark arrester that is maintained and not modified; • Carry shovels, water, and fire extinguishers that are rated at a minimum as ABC-10 pound on all equipment and vehicles. If a fire

TABLE 9	TWE PROJECT COMMITTED ENVIRONMENTAL MITIGATION MEASURES		
NO.	PHASE(S)	TOPIC	DESCRIPTION OF MITIGATION MEASURE
			spreads beyond the suppression capability of workers with these tools, all workers will cease fire suppression action and leave the area immediately via pre-identified escape routes; • Initiate fire suppression actions in the work area to prevent fire spread to or on federally-administered lands. If fire ignitions cannot be prevented or contained immediately, or it may be foreseeable that a fire would exceed the immediate capability of workers, the operation must be modified or discontinued. No risk of ignition or re-ignition will exist upon leaving the operation area; • Notify the appropriate fire center immediately of the location and status of any escaped fire; • Review weather forecasts and the potential fire danger prior to any operation involving potential sources of fire ignition from vehicles, equipment, or other means. Prevention measures to be taken each workday will be included in the specific job briefing. Consideration will be given to additional mitigation measures or temporary discontinuance of the operation during periods of extreme wind and dryness; • Operate all vehicles on designated roads, or park in areas free of vegetation; • Operate welding, grinding, or cutting activities in areas cleared of vegetation within range of the sparks for that particular action. A spotter will be required to watch for ignitions; and • Use only diesel-powered vehicles in areas where excessive heat from vehicle exhaust systems could start brush or grass fires.

4.0 TWE PROJECT ALTERNATIVES

Section 4.0 describes the range of alternatives presented during the TWE Project Public Scoping process. In January 2011, the BLM and Western issued the Notice of Intent (NOI) to prepare an Environmental Impact Statement (EIS) for the TWE Project. The NOI was published in the Federal Register on January 4, 2011 starting the 90-day public scoping process. The joint lead agencies held 23 scoping meetings in Wyoming, Colorado, Utah and Nevada.

Section 4.0 provides information on siting areas and alternative facility locations for the TWE Project terminals and ground electrode systems, which have been developed by TransWest for the lead agencies consideration. Section 4.0 also discusses the feasibility of undergrounding portions of the TWE Project, in response to the lead agencies' request for information on this technology alternative.

Section 4.0 describes alternatives to the proposed TWE Project as follows:

- Section 4.1 – Transmission Line Alternatives, describes the alternative line design characteristics, structure designs, and construction, operation and maintenance practices for the corridor routing alternatives.

- Section 4.2 – Project Facility Alternatives, describes the general siting areas, and proposed and alternative facility locations for the Northern and Southern Terminals and ground electrode systems. These alternatives are recommended by TransWest for inclusion in the DEIS.

- Section 4.3 – System Alternatives, describes system alternatives presented during public scoping. The system alternatives, termed System Alternative 1, 2 and 3, were initially suggested by TransWest in the *TransWest Express Transmission Project ROW Application SF 299 (Amended from December 2008) January 2010* (TWE 2010b). System Alternative 1 was removed from further consideration as described previously in Section 2.4.2. System Alternatives 2 and 3 are recommended by TransWest for inclusion in the DEIS.

- Section 4.4 – Undergrounding Alternative, describes technology and feasibility issues associated with undergrounding portions of the TWE Project. TransWest is not recommending this technology alternative be considered in detail in the DEIS. Technical issues associated with potential undergrounding alternatives are discussed.

4.1 Transmission Line Alternatives

4.1.1 Transmission Line Design Alternatives

The transmission line design characteristics and alternative structure designs would be the same for the corridor routing alternatives as previously described for the proposed TWE Project in Section 3.1.

4.1.2 Transmission Line Construction, Operation and Maintenance Practices

The construction, operation and maintenance practices for the corridor routing alternatives would be the same as previously described for the proposed TWE Project in Sections 3.5 and 3.6.

4.2 Project Facility Alternatives

4.2.1 Northern Terminal

The location for the Northern Terminal will be finalized during engineering and design. The general planned location for the Northern Terminal is proposed to be within a general siting area, shown on Map Exhibit 3. For purposes of the DEIS analysis, Map Exhibit 3 shows a preliminary location for the Northern Terminal and its relationship to the TWE Project proposed corridor and grid interconnections. Considerations in siting the location of the Northern Terminal within this general area include:

- Land Ownership - use of private lands over public lands is preferable.
- Land Use - other current and planned land uses in the area, in particular other infrastructure that is being planned and permitted.
- Environmental Constraints - avoidance of sensitive resources, including sensitive wildlife habitats, cultural resource sites, and wetlands.
- Topography - use of level terrain over more rugged terrain is preferable.
- Access to the TWE Project transmission line corridors coordinated with other existing and planned infrastructure and which minimize line crossings.
- Interconnections with existing, planned and potential transmission lines such that line crossings are minimized and conflicts with other existing and planned infrastructure are avoided.

4.2.2 Southern Terminal

The location for the Southern Terminal will be finalized during engineering and design. The location for the Southern Terminal is proposed to be within a general siting area, shown on Map Exhibit 4. For purposes of the DEIS analysis, Map Exhibit 4 shows preliminary locations for the Southern Terminal and its relationship to the TWE Project proposed corridor and grid interconnections. Siting criteria used in selecting this siting area, and the final site location are similar to those described for the Northern Terminal.[11]

4.2.3 Ground Electrode System Alternatives

The location of the ground electrode systems will be finalized during engineering and design. For purposes of the DEIS analysis, general siting areas and conceptual site locations have been identified for the proposed and alternative northern and southern ground electrode systems as shown on Map Exhibits 5 and 6. The ground electrode site could be located anywhere within the siting areas. Additionally, for the DEIS analysis, the lower voltage connector lines from the ±600 kV DC transmission line proposed route to each of the conceptual ground electrode sites are shown on Map Exhibits 5 and 6.

The proposed TWE Project and alternative siting areas were selected based on feasibility studies that considered surface and deep earth geology, proximity to the proposed and alternative routes,

[11] Criteria are the same, except interconnections with the planned Energy Gateway Projects do not apply to the Southern Terminal.

proximity to underground infrastructure (oil, gas and water wells, pipelines, etc.), and topography. Major factors in selecting the alternative sites were:

1. Geology and ground resistivity of the area. The primary need is for deep sedimentary basins with large volumes of sediments having a low resistivity. Locations with potentially high resistance geologic formations that could potentially interfere with the current path are generally avoided.

2. Distance from grounded metallic infrastructure that might be negatively impacted by DC ground currents. In general, this consideration results in the electrode site being a few miles or more from power plants, electrical substations, underground pipelines, and active oil or gas wells. The ground electrodes cannot be located within 2 miles of major pipelines due to the risk of having a corrosive impact on nearby metallic structures. Ground electrodes located within 2 – 10 miles of major pipelines may require additional or modified corrosion protection systems.

3. Land use constraints such as protected areas (National Parks, wilderness, etc.) and sensitive resource areas (e.g., sage-grouse leks and core areas). Secondary consideration is given to topography as it would be impractical to drill the ground wells in mountainous topography.

More detailed information will be required to make a final determination of the proposed ground electrode sites including: a) availability of public lands or private lands; b) detailed measurements of ground resistivity; c) chemical and thermal characteristics of the soil at the site; and d) a detailed analysis of grounded metallic infrastructures in the area. The location and layout of the selected ground electrode facility will also take into consideration existing and planned land uses, environmental constraints, routing of the ±600 kV DC transmission line, and the length and routing of the low voltage connector lines.

4.2.3.1 Northern Ground Electrode Alternative Sites

The ‘Separation Flat’ siting area contains the proposed northern ground electrode site. This proposed siting area would accommodate all routes into the Northern Terminal. The five alternative sites shown on Map Exhibit 5 would also connect to the Northern Terminal: Eight Mile Basin, Separation Creek, Shell Creek, Little Snake East, and Little Snake West.

4.2.3.2 Southern Ground Electrode Alternative Sites

The ‘Mormon Mesa-Carp Elgin Road’ siting area contains the proposed southern ground electrode site that would provide connection to the Southern Terminal. The two alternative sites shown on Map Exhibit 6 would also connect to the Southern Terminal: Halfway Wash E and Halfway Wash-Virgin River.

4.3 System Alternatives

TransWest amended the Preliminary ROW Application SF 299 to eliminate System Alternative 1 from further consideration in August 2012. Only two system alternatives remain, System Alternative 2 and System Alternative 3. Section 4.3 addresses two system alternatives considered for the TWE Project during the public scoping process as follows:

- Section 4.3.1 provides an overview of System Alternatives 2 and 3.

- Section 4.3.2 describes the system alternatives according to the conditions under which each system alternative would meet the TWE Project purpose and need and the alternative's specific components and design characteristics.

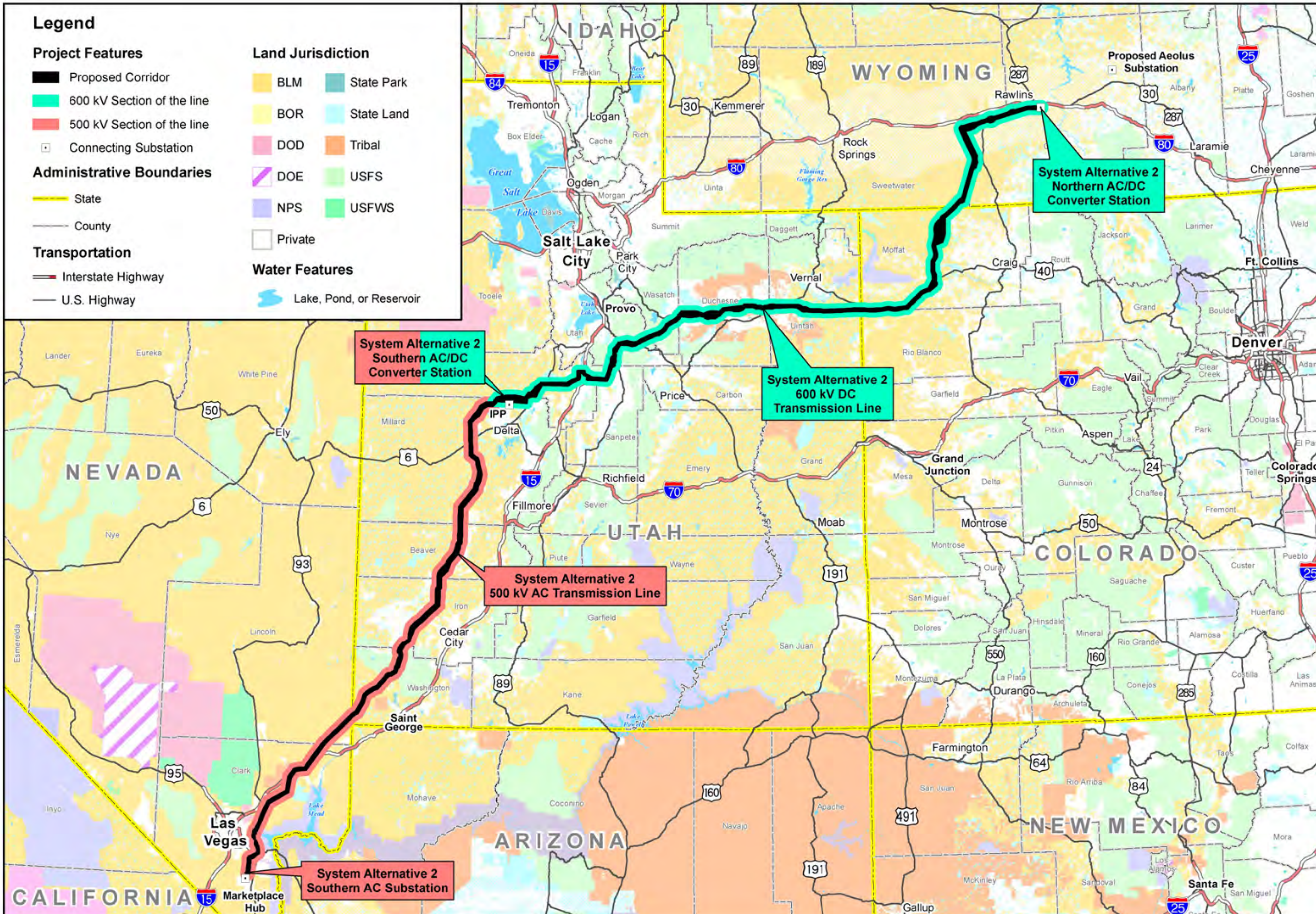
- Section 4.3.3 discusses how the system alternatives would differ from the proposed TWE Project with respect to construction, operation, and maintenance practices.

- Section 4.3.4 provides a comparison of the system alternatives to the proposed TWE Project.

4.3.1 Overview of Alternative Systems

System Alternative 2 - System Alternative 2 would be an alternative system configuration, which would replace the proposed TWE Project (Map Exhibit 7). This alternative would entail TransWest constructing and operating a 3,000 MW, ±600 kV DC transmission line approximately 375 miles in length, from the Northern Terminal to a new AC/DC converter station near the existing IPP Substation near Delta, Utah. From the new AC/DC converter station in Utah, a single circuit 1,500 MW, 500 kV AC transmission line, approximately 350 miles in length, would be constructed to one of the existing substations in the Eldorado Valley, south of Boulder City, Nevada (Marketplace Hub).

System Alternative 3 - System Alternative 3 would be a phased approach to building and operating the proposed TWE Project (Map Exhibit 8). This phased approach would entail construction of a 3,000 MW, ±600 kV DC transmission line approximately 375 miles in length between the location of the proposed Northern Terminal to the IPP substation near Delta, Utah and operated initially as a 1,500 MW, 500 kV AC transmission system. For AC operation, the initial phase of this system alternative would require 500/345 kV substation connections near the IPP line in Millard County, Utah and construction of a 500 kV Series Compensation Station near the halfway point of the northern segment. Full development of the TWE Project using this phased build out approach would involve constructing the remaining portion of the 3,000 MW, ±600 kV DC line from IPP to the Southern Terminal, south of Boulder City, Nevada and converting operations to a DC system.



Map Exhibit 7

System Alternative 2: DC from Wyoming to IPP, AC from IPP to Marketplace Hub

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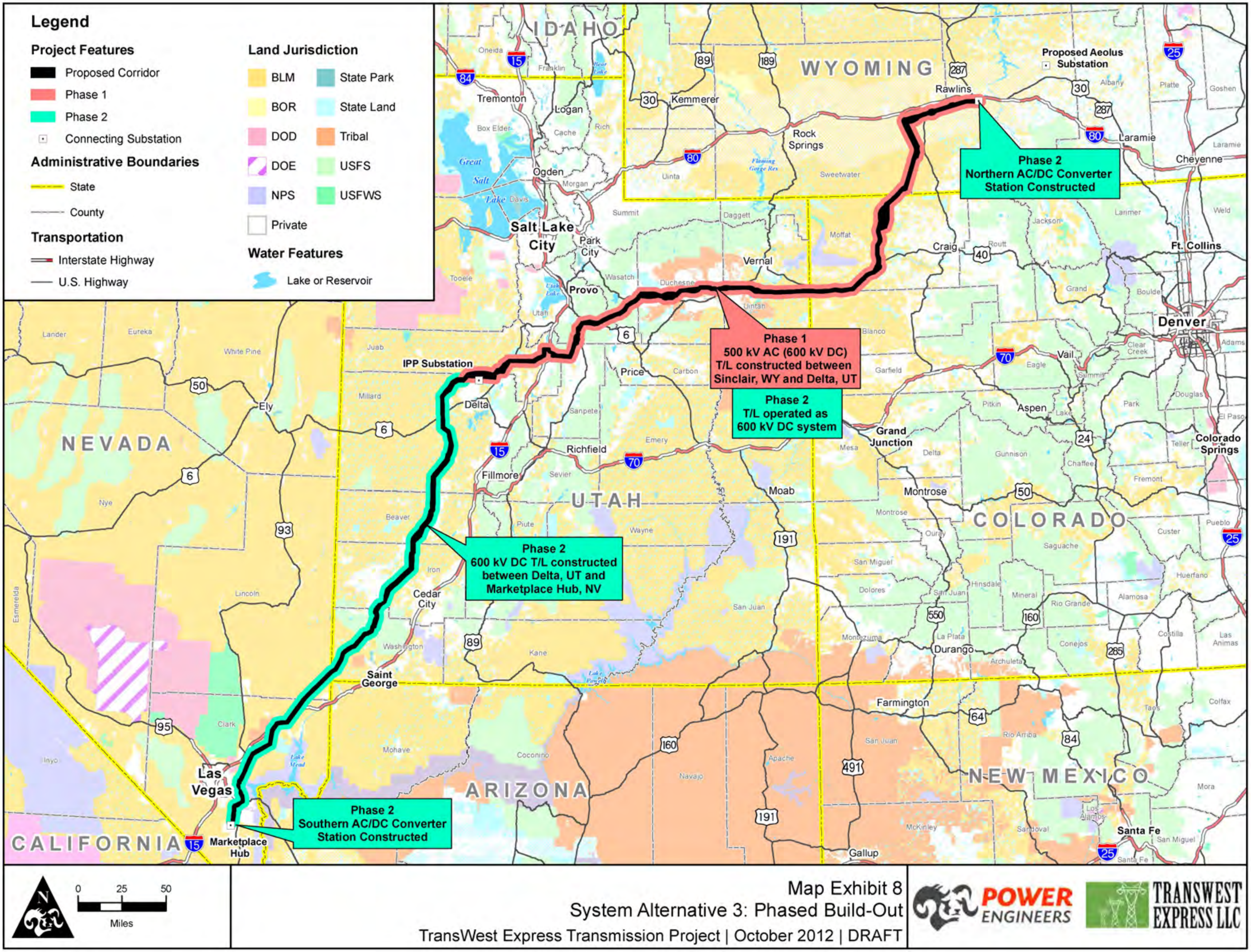

Map Exhibit 8

System Alternative 3: Phased Build-Out

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4.3.2 Alternative Systems' Purpose and Need and Design Characteristics

4.3.2.1 System Alternative 2 – DC from Wyoming to IPP, AC from IPP to Marketplace Hub

System Alternative 2 would meet the TWE Project's stated objectives only if transmission capacity becomes available and can be utilized to transmit energy delivered by the TWE Project from Delta, Utah to Southern California. Under this system alternative, the delivery of energy to markets in the Desert Southwest region would be through both the new 1,500 MW 500 kV transmission line and through the existing 2,400 MW 500 kV DC transmission system, IPP's 'Southern Transmission System' (STS), between Delta, Utah and Adelanto, California. Because capacity is not currently available on the STS, System Alternative 2 does not currently meet the TWE Project's purpose and need. Should capacity become available in the future, TransWest would only consider implementing this system alternative under the conditions that sufficient capacity, approximately 1,500 MW, was commercially available to transmit energy delivered by the TWE Project to California; and that TransWest is able to establish commercial interconnection agreements with the utility owning and operating the IPP transmission line (currently Los Angeles Department of Water and Power (LADWP)). TransWest will provide the lead agencies with notice if a decision is made to implement System Alternative 2.

System Alternative 2 would replace the proposed TWE Project. This alternative would entail a 3,000 MW, ±600 kV DC transmission line approximately 375 miles in length, from the Northern Terminal to a new AC/DC converter station near the existing IPP substation near Delta, Utah. From the new AC/DC converter station in Utah, a single circuit 1,500 MW, 500 kV AC transmission line, approximately 350 miles in length, would be constructed to one of the existing substations in the Eldorado Valley, south of Boulder City, Nevada (Marketplace Hub). See Map Exhibit 6.

System Alternative 2 would entail the following specific facilities and actions:

a. Construction of the Northern Terminal and ground electrode system (identical facilities to the proposed TWE Project);
b. Construction of a new AC/DC converter station and an adjacent 500/345 kV AC substation near the IPP in Millard County, Utah;
c. Construction of a ground electrode system within 50 miles of Delta, Utah;
d. Construction of a double circuit 345 kV AC line between the new 500/345 kV AC Substation near IPP to the existing IPP 345 kV AC substation adjacent to the existing IPP AC/DC converter station. The length of the double circuit 345 kV AC connection is estimated to be less than five miles;
e. Construction of a ±600 kV DC transmission line, approximately 375 miles long, from the Northern Terminal to the new AC/DC converter station and associated 500/345 kV substation near IPP (northern segment, similar to proposed TWE Project);
f. Construction of a single circuit, 1,500 MW, 500 kV AC line from the new 500/345 kV AC substation near IPP to one of the existing Marketplace Hub substations in the Eldorado Valley (southern segment); and
g. Construction of a series compensation station (similar to a small 500 kV substation) adjacent to the 500 kV AC transmission line, near the halfway point in the 500 kV AC line southern segment.

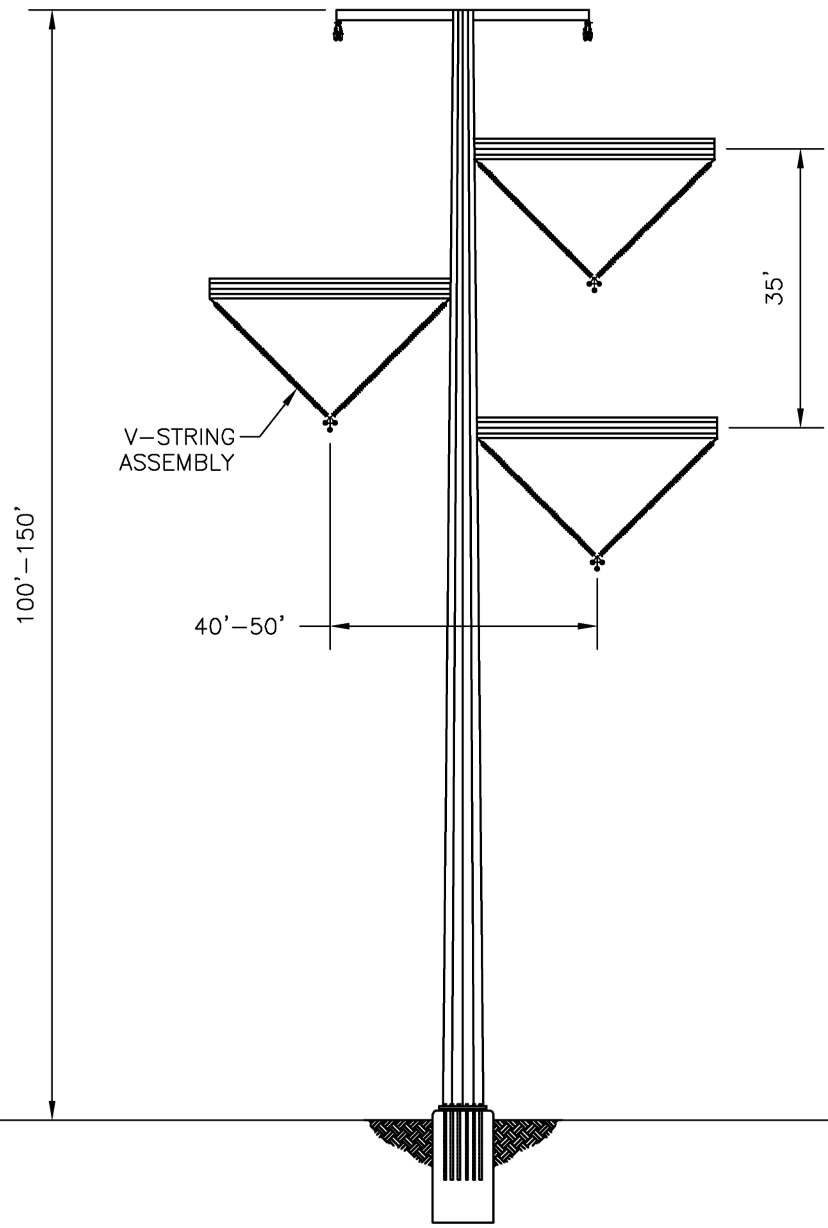
Compared to the proposed TWE Project, System Alternative 2 would: 1) replace the ±600 kV DC transmission line with a single circuit 500 kV AC line, from near IPP in Millard County, Utah to one of the existing Marketplace Hub substations in Clark County, Nevada[12]; 2) eliminate the Southern Terminal and ground electrode system in Clark County, Nevada and replace these facilities with similar facilities near IPP in Millard County, Utah; 3) construct additional new facilities, including a 500/345 kV AC substation, a double circuit 345 kV transmission line, less than five miles in length, and a 500 kV series compensation station, near the halfway point in the 500 kV AC line.

System Alternative 2 would require both a 500 kV single circuit AC configuration and a 345 kV double circuit AC configuration. System Alternative 2 would require a single circuit 500 kV configuration and structures, similar to the structure design shown in Figure 29. The 500 kV single circuit configuration would require three sets of conductor bundles, one steel shield wire, and one OPGW. The components for the 500 kV structures including foundations, conductors, insulators, and associated hardware, overhead shield (ground) wires, and grounding rods, would be similar to those described for the ±600 kV DC transmission line.

One double circuit 345 kV transmission line would be required for System Alternatives 2 and 3. The 345 kV double circuit structures would be either self supporting steel lattice towers or single shaft tubular steel poles. Figure 30 shows a typical steel pole design. The 345 kV double circuit configuration would require six sets of conductor bundles, one steel shield wire, and one OPGW. The components for the 345 kV structures including foundations, conductors, insulators, and associated hardware, overhead shield (ground) wires, and grounding rods, would be similar to those described for the ±600 kV DC transmission line.

Map Exhibit 9 depicts the siting areas for the System Alternative 2 AC/DC converter station, 500/345 kV AC substation, ground electrode system, double circuit 345 kV connector line and the 500 kV series compensation station.

[12] Level 1 and Level 2 of the co-location distances framework applies to the 1,500 MW, 500 kV AC transmission portion of System Alternative 2. The selective use of Level 2 co-location distances can be used between the 1,500 MW, 500 kV AC transmission line segment and transmission lines with a voltage level of 500 kV and lower.



NOTES

1. DIMENSIONS SHOWN ARE FOR ILLUSTRATION PURPOSES ONLY.

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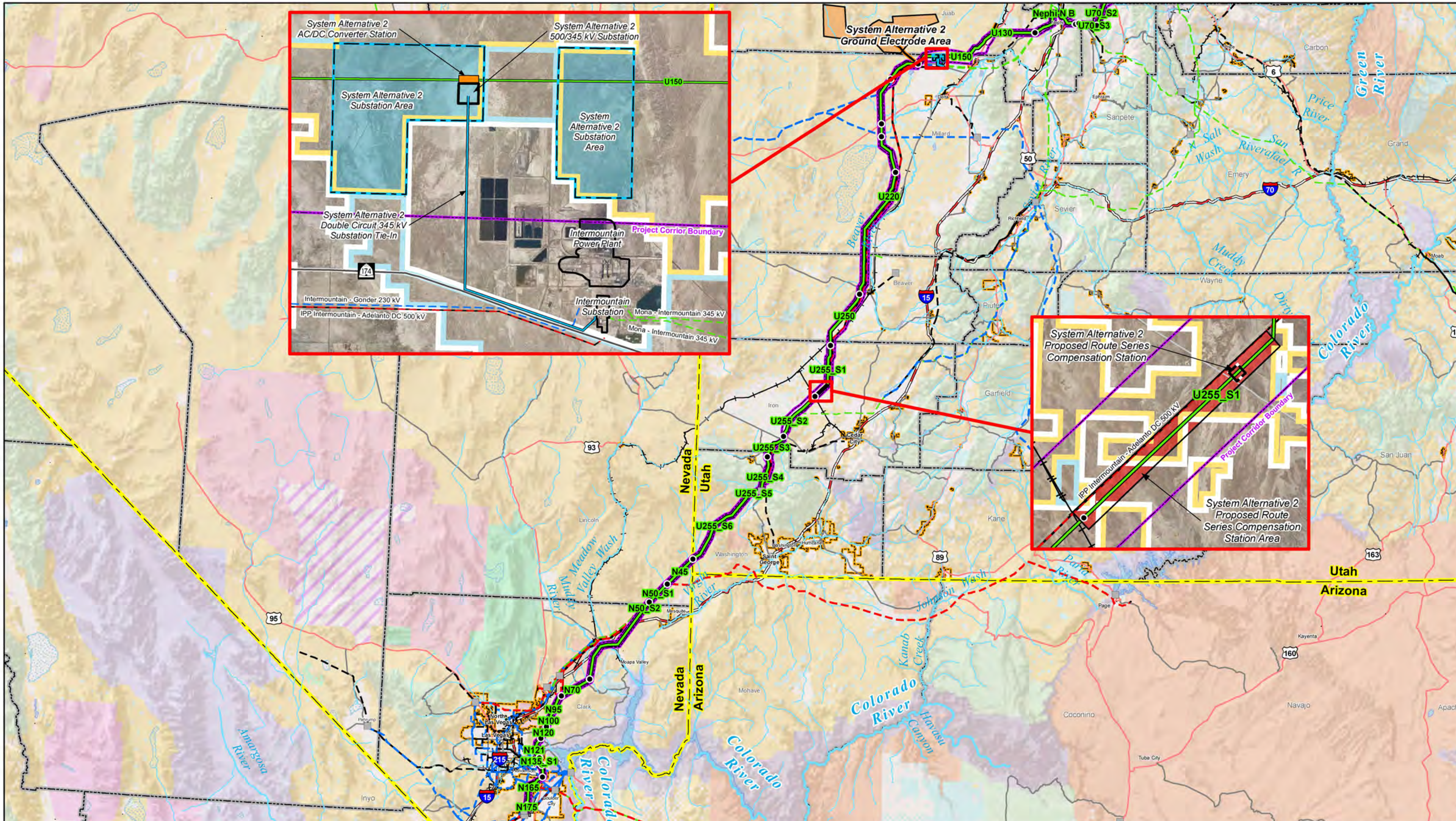
FIGURE 29

TYPICAL 500kV AC SINGLE CIRCUIT TUBULAR POLE STRUCTURE



TransWest Express Transmission Project
October 2012 Draft

Map Exhibit 9

System Alternative 2 Components

Project Features
- Proposed Reference Line
- Route Segment Node
- Route Corridor
- Terminal Siting Area
- Ground Electrode Area
- Ground Electrode Site
- 34.5 kV Electrode Line

Administrative Boundaries
- Municipal Boundary

Existing Transmission
- 500 kV Line
- 500 kV DC Line
- 345 kV Line
- 287 kV Line
- 230 kV Line
- 138 kV Line
- Substation

Land Jurisdiction
- Indian Reservation
- State Land
- USDA Forest Service
- State Park or Recreation Area
- U.S. Department of Energy
- U.S.Department of Defense
- National Park or National Monument
- USDI Bureau of Land Management
- USDI Bureau of Reclamation
- USDI Fish and Wildlife Service

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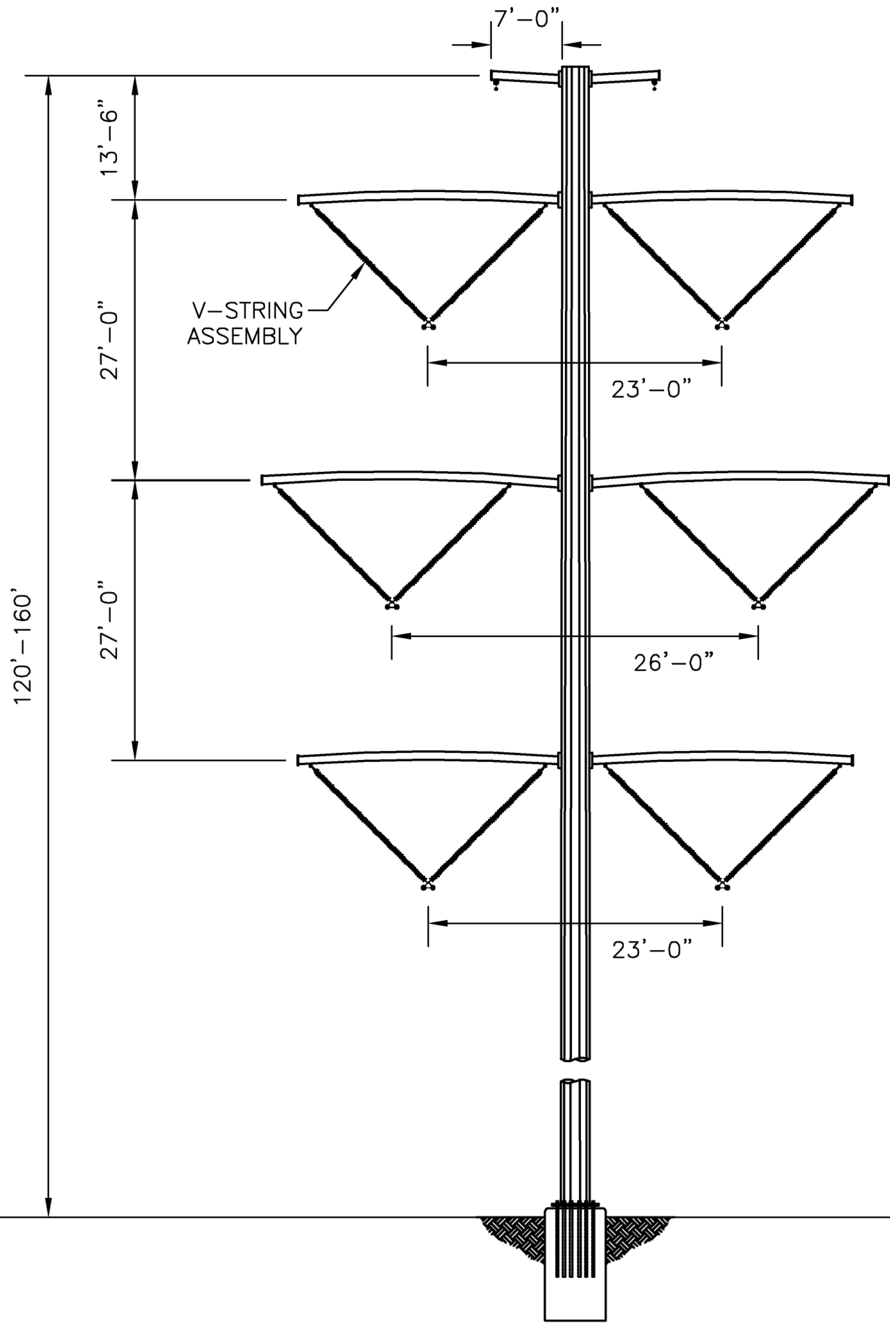

NOTES

1. DIMENSIONS SHOWN ARE FOR ILLUSTRATION PURPOSES ONLY.

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FIGURE 30

TYPICAL 345kV AC DOUBLE CIRCUIT
SELF SUPPORTING STEEL POLE STRUCTURE

4.3.2.3 System Alternative 3 – Phased Build Out

Similar to System Alternative 2, this System Alternative would meet the TWE Project's stated objectives only if transmission capacity becomes available and can be utilized to transmit energy delivered by the TWE Project from Delta, Utah to Southern California. This initial delivery of energy to markets in the Desert Southwest region would be through the existing 2,400 MW, 500 kV DC transmission system, and IPP's STS. This system alternative would meet the TWE Project's objectives and is considered feasible, however, it is more costly than building out the full system as a single non-phased project and would only be required if the demand for Wyoming resources in the Desert Southwest proves to be slower in development than expected. Construction of the line between Utah and Nevada, the Southern Terminal and completion of the Northern Terminal would be phased, however, to occur at some point in the future when market demands warrant converting the line's operation from 1,500 MW to 3,000 MW.

Should capacity become available, TransWest would only consider implementing this system alternative under the condition that sufficient capacity, approximately 1,500 MW, was commercially available to transmit energy delivered by the TWE Project to California; and that TransWest is able to establish commercial interconnection agreements with the utility owning and operating the IPP transmission line (currently LADWP). A market analysis would also need to be completed with results showing a phased approach to be commercially beneficial. TransWest will provide the lead agencies with notice if a decision is made to implement System Alternative 3.

System Alternative 3 is similar to the proposed TWE Project, except the project would be built and operated in phases. This phased approach would entail construction of a 3,000 MW, ±600 kV DC transmission line approximately 375 miles in length between the location of the proposed Northern Terminal to the IPP substation near Delta, Utah and operated initially as a 1,500 MW, 500 kV AC transmission system. For AC operation, the initial phase of this system alternative would require 500/345 kV substation connections near the IPP in Millard County, Utah and construction of a 500 kV Series Compensation Station near the halfway point of the northern segment. Full development of the TWE Project using this phased build out approach would involve constructing the remaining portion of the 3,000 MW, ±600 kV DC line from IPP to the Southern Terminal, south of Boulder City, Nevada and converting operations to a DC system (see Map Exhibit 8).

The TWE Project would be energized in phases. Phase 1 would entail the following:

a. Construction of the 500 kV substation portion of the Northern Terminal. The adjacent AC/DC converter station in Wyoming would be built in Phase 2;
b. Construction of a 500/345 kV AC substation in the vicinity of the existing IPP 345 kV substation near Delta, Utah;
c. Construction of a single circuit 500 kV AC line from the Northern Terminal near Sinclair, Wyoming to the new 500/345 kV AC substation near IPP (northern line segment). The single circuit 500 kV AC line would be designed to operate at both 500 kV AC and ±600 kV DC for easy conversion to ±600 kV DC operation;
d. Construction of a 500 kV series compensation station near the halfway point of the 500 kV AC northern line segment;
e. Construction of a double circuit 345 kV transmission line connecting the new 500/345 kV AC substation to the existing IPP 345 kV substation. The length of the double circuit 345 kV AC connection is estimated to be less than five miles; and

f. Energization of Phase 1 of System Alternative 3 as a 1,500 MW, 500 kV AC system.

Phase 2 would entail the following:

a. Construction of the AC/DC converter station portion of the Northern Terminal in Wyoming and construction of the entire Southern Terminal in Nevada;
b. Construction of the ground electrodes for both the Northern and Southern Terminals (see Map Exhibits 5 and 6);
c. Construction of the ±600 kV DC transmission line between IPP and the Southern Terminal (southern line segment);
d. Removal of the connection to the IPP substation at Delta, Utah and connecting the Phase 1 500 kV AC line (constructed during Phase 1, designed for conversion to ±600 kV DC and operated at 500 kV AC during Phase 1) to the Phase 2 ±600 kV DC line between Delta, Utah and the Southern Terminal;
e. Convert the operation of the TWE Project to a 3,000 MW, ±600 kV DC system;
f. Decommission the 500/345 kV AC substation at IPP;
g. Decommission the double circuit 345 kV transmission line at IPP; and
h. Decommission the series compensation station on the 500 kV AC northern line segment.

System Alternative 3 would utilize the same transmission corridor as the proposed TWE Project. Construction of the Northern Terminal in Wyoming would occur in phases. Phase 1 would require the construction of the AC substation portion of the Northern Terminal complex. In Phase 2, the AC/DC converter station portion of the Northern Terminal complex would be constructed adjacent to the 500 kV AC substation constructed in Phase 1, completing the Northern Terminal. The AC operation of the northern line segment would require the construction of a 500/345 kV substation near IPP. Upon conversion of the line to DC operations, this 500/345 kV substation would be decommissioned along with the double circuit 345 kV line. The 500 kV AC line constructed in Phase 1 from Wyoming to Utah (northern line segment) would be designed and constructed as a DC line to a criteria that would enable it to be initially operated at 500 kV AC and then converted from 500 kV AC operation to ±600 kV DC operation. No further changes to the transmission line would be required to convert the line from AC to DC operation. AC operation of the northern line segment would require the construction of a 500 kV series compensation station near the halfway point of this segment. Upon conversion of the line to DC operations, this 500 kV series compensation station would be decommissioned.

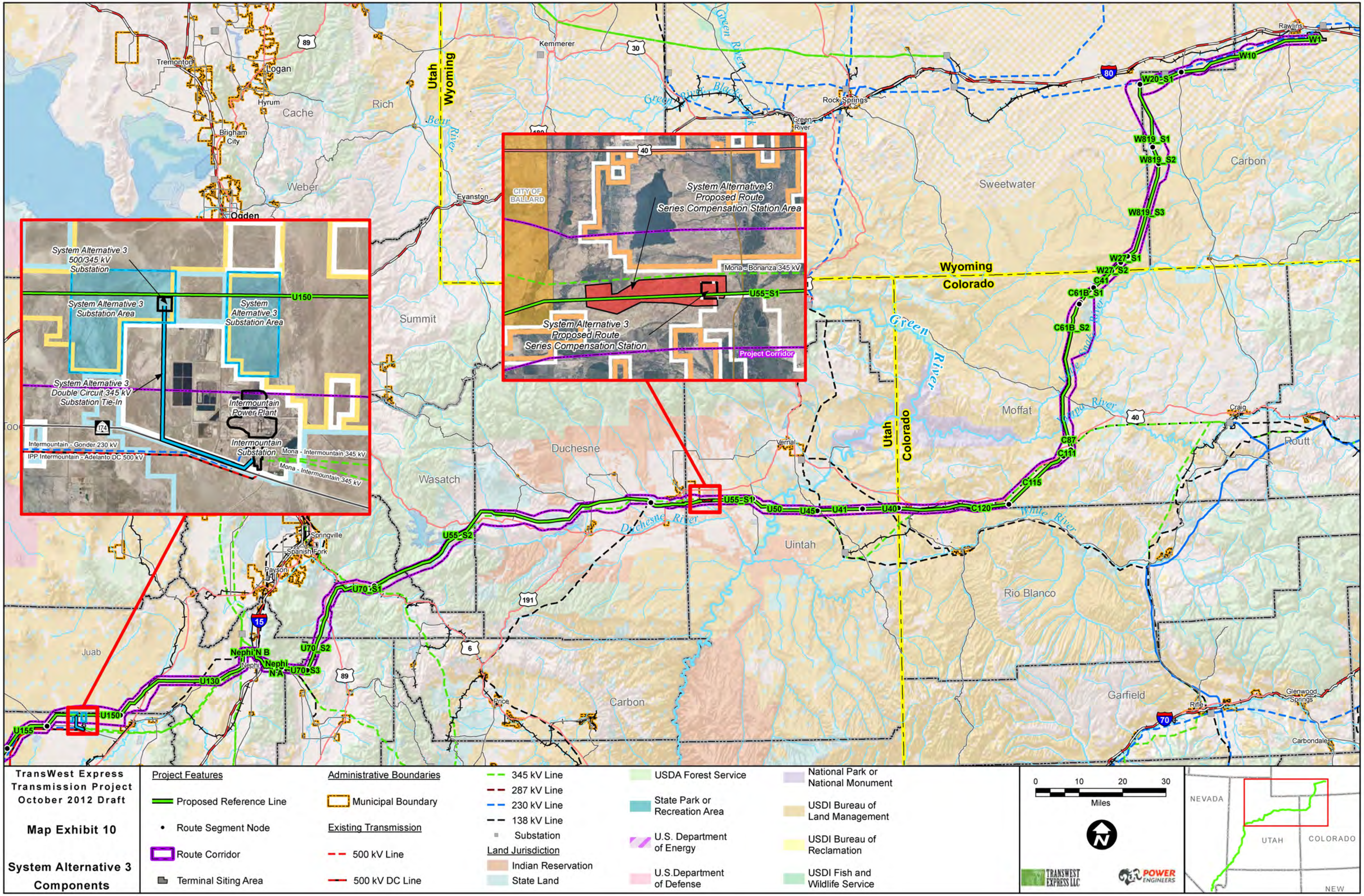
Phase 1 of System Alternative 3 would require a single circuit 500 kV AC configuration designed and constructed to meet the ±600 kV DC criteria. The typical Phase 1 single circuit 500 kV AC structures would be similar in appearance to those shown in Figure 29. The single circuit 500 kV AC configuration would require three sets of conductor bundles, one steel shield wire, and one OPGW. The conversion from 500 kV AC to ±600 kV DC would not require physical changes to the structure or wire system constructed in Phase 1 as one of the three conductor bundle sets would be de-energized and left in place.

Phase 1 of System Alternative 3 would also require one 345 kV double circuit transmission line. The 345 kV double circuit structures would be either self supporting steel lattice towers or single shaft tubular steel poles. Figure 30 shows a typical steel pole design. The 345 kV double circuit configuration would require six sets of conductor bundles, one steel shield wire, and one OPGW. The components for the 345 kV structures including foundations, conductors, insulators, and associated hardware, overhead shield (ground) wires, and grounding rods, would be similar to those described for the ±600 kV DC transmission line.

Map Exhibit 10 depicts the siting areas for the System Alternative 3 components, including the 500/345 kV AC substation, double circuit 345 kV connector lines and the 500 kV series compensation station.

4.3.3 Construction, Operation and Maintenance Activities of System Alternatives

The construction, operation, and maintenance activities described for the proposed TWE Project would be very similar for most aspects of the system alternatives. Applicant-committed mitigation measures would also apply to these alternatives. This section discusses key differences between the system alternatives and the proposed TWE Project.



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October 2012 Draft

Map Exhibit 10

System Alternative 3 Components

4.3.3.1 System Alternative Construction Activities, Workforce and Equipment Requirements

The construction activities, workforce and equipment requirements for the transmission line and terminals would be very similar or the same for the system alternatives as described for the proposed TWE Project in Section 3.5.9. Construction of each substation or series compensation station would require approximately 135 personnel. The construction activities, workforce and equipment requirements for the substations and series compensation stations for System Alternatives 2 and 3 would be approximately as shown in Table 10. Special construction methods and Applicant-committed mitigation measures would apply to these alternatives, as presented in Sections 3.5.7 and 3.7.

TABLE 10 ESTIMATED PERSONNEL AND EQUIPMENT FOR SYSTEM ALTERNATIVE SUBSTATIONS

ACTIVITY	PEOPLE	QUANTITY AND TYPE OF EQUIPMENT	
Survey Crew	4	2	Pickup trucks
Site Management Crew	8-10	2	Office trailers
		3	Pickups
		4	Generators
Site Development – Civil Work Crew	20-25	4	Scrapers
		2	Dozers (ripper)
		2	Motor graders
		2	Roller compactors
		2	Excavators
		4	Dump trucks
		3	Water trucks
		1	Mechanics truck
		1	Fuel truck
		2	Pickup trucks
		6	Carry alls
Fence Installation Crew	10-15	1	Pickup truck
		1	Boom truck
		2	Carry alls
		1	Backhoe
		1	Concrete truck
		1	Reel stand truck
		2	Bobcats
Equipment Footings Installation	20-25	2	Hole diggers

TABLE 10 ESTIMATED PERSONNEL AND EQUIPMENT FOR SYSTEM ALTERNATIVE SUBSTATIONS			
ACTIVITY	PEOPLE	QUANTITY AND TYPE OF EQUIPMENT	
Crew		2	Boom trucks
		1	Excavator
		3	Concrete trucks
		1	Dump truck
		1	Roller compactor
		2	Plate compactors
		1	Backhoe
		2	Bobcats
		1	Mechanics truck
		1	Fuel truck
		1	Water truck
		2	Pickup trucks
		4	Carry alls
Cable Trench, Conduits, and Station Grounding Crew	10-12	2	Trenchers
		2	Dozers (ripper)
		2	Roller compactors
		2	Plate compactors
		2	Excavators
		1	Boom truck
		3	Pickup trucks
		2	Flatbed trucks
		4	Carry alls
		1	Air compressor
		1	Backhoe
		1	Mechanics truck
		1	Fuel truck
		1	Dump truck
		1	Reel stand truck
Steel Structure and Bus Installation Crew, Control Buildings Construction Crew, Equipment Assembly and	16-24	2	Cranes, RT
		2	High capacity cranes
		4	Boom trucks

TABLE 10 ESTIMATED PERSONNEL AND EQUIPMENT FOR SYSTEM ALTERNATIVE SUBSTATIONS			
ACTIVITY	PEOPLE	QUANTITY AND TYPE OF EQUIPMENT	
Erection Crew		6	Manlifts
		4	Welder trucks
		2	Carry alls
		3	Pickup trucks
		2	Flatbed trucks
		1	Mechanics truck
		4	Vans
		2	Flatbed trucks
Control Building and Wiring Crew	16-20	2	Boom trucks
		4	Manlifts
		3	Wire pullers-small
		2	Reel stand trucks/trailers
		4	Vans
		4	Pickup trucks
		2	Carry alls
		1	Splicing van
		2	Concrete trucks
		1	Bobcat
		1	Trencher
		2	Plate compactors

The above table reflects estimated personnel requirements, which may reach as high as 135 for each substation or series compensation station construction, including maintenance, management, and quality control personnel.

4.3.3.2 System Alternative Construction Schedules

The conceptual construction schedule for the transmission line for System Alternative 2 would employ a three spread approach very similar to the schedule presented for the proposed TWE Project in Section 3.5.9.1 and shown on Figure 18. For System Alternative 2, the conceptual construction schedules shown in Figure 18 would need to be increased by approximately ten weeks to accommodate the additional work required for installing an AC transmission line in place of a DC transmission line.

The conceptual construction schedule for the transmission lines for System Alternative 3 follows a phased approach and is shown on Figure 33. The conceptual construction schedule shown on Figure 33 would be used for both Phase 1 and Phase 2 of System Alternative 3.

The construction schedules for the terminal, ground electrodes, substations and series compensation stations for System Alternatives 2 and 3 would differ from the proposed TWE Project, as illustrated on Figures 31 and 32.

4.3.3.3 Induced Currents on AC Transmission Systems

Unlike the proposed TWE Project ±600 kV DC transmission line, which presents no risk of inducing currents line due to the static nature of the DC electrical and magnetic fields, AC transmission systems can induce currents. Mitigation measures for AC inductive currents would be implemented as necessary for the AC portions of System Alternatives 2 and 3.[13] Mitigation measures would be incorporated into the siting of the AC transmission line ROWs, as well as through transmission line design and operation measures. Measures to mitigate induced current impacts on pipelines, railroads and other land uses are described in Appendix D.

[13] The proposed TWE Project includes short sections of AC transmission lines to connect between the terminals and existing and planned AC transmission systems. Potential impacts from AC induced currents on these system interconnection lines would be mitigated, if necessary, as described herein for the system alternatives.

SYSTEM ALTERNATIVE - 2		TOTAL DURATION	111 week

TASK	DURATION (WEEKS)
AC/DC CONVERTER STATION (NEAR IPP)	
SITE GRADING	13
BELOW-GRADE WORK (FOUNDATIONS, CONDUIT, GROUNDING)	32
BUILDING CONSTRUCTION	35
EQUIPMENT INSTALLATION	39
EQUIPMENT TESTING	21
OPERATIONAL	9
500/345 kV AC SUBSTATION (NEAR IPP)	
SITE GRADING	22
BELOW-GRADE WORK (FOUNDATIONS, CONDUIT, GROUNDING)	22
EQUIPMENT INSTALLATION	26
CONTROL BUILDING INSTALLATION	22
EQUIPMENT TESTING	13
OPERATIONAL	7
IPP 345 kV AC SUBSTATION MODIFICATION	
SITE GRADING	13
BELOW-GRADE WORK (FOUNDATIONS, CONDUIT, GROUNDING)	15
EQUIPMENT INSTALLATION	17
CONTROL BUILDING MODIFICATION	13
EQUIPMENT TESTING	7
OPERATIONAL	3
SERIES COMPENSATION STATION	
SITE GRADING	10
BELOW-GRADE WORK (FOUNDATIONS, CONDUIT, GROUNDING)	15
CONTROL HOUSE CONSTRUCTION	17
EQUIPMENT INSTALLATION	16
EQUIPMENT TESTING	10
OPERATIONAL	3

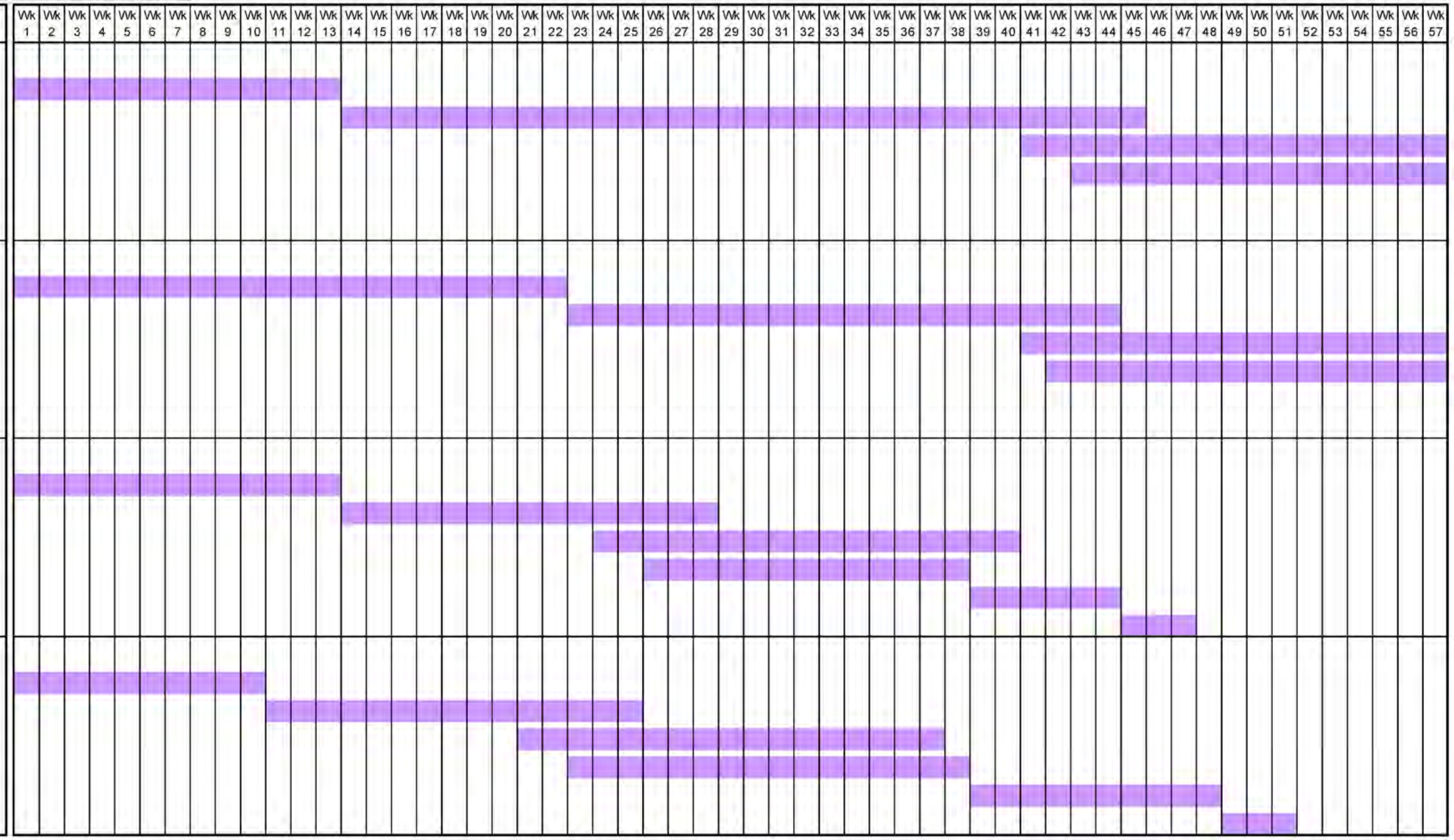

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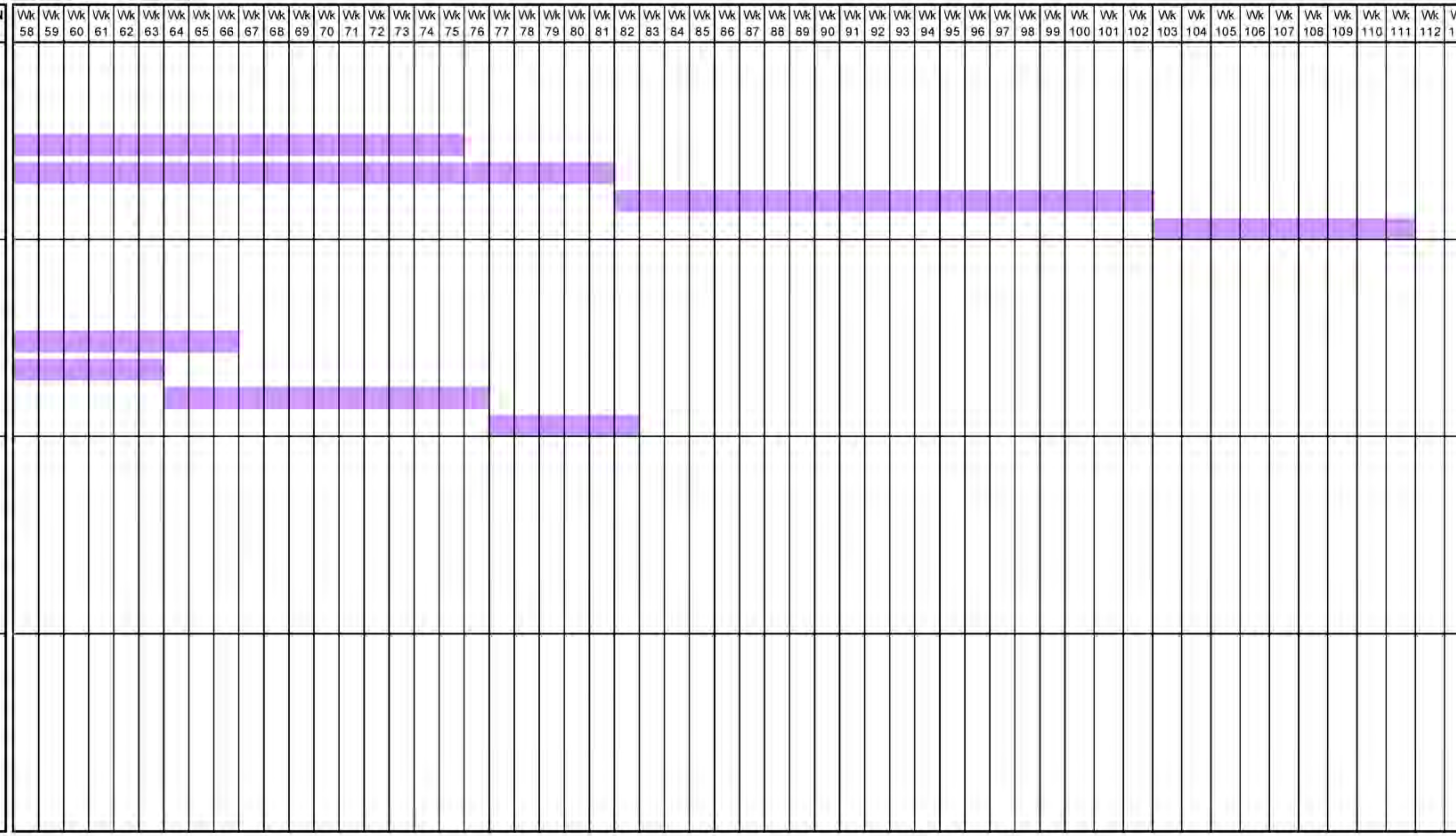
FIGURE 31
CONSTRUCTION SCHEDULE FOR SYSTEM ALTERNATIVE 2 TERMINALS, SUBSTATIONS AND SERIES COMPENSATION STATION – SHEET 1

SYSTEM ALTERNATIVE - 2	TOTAL DURATION	111 week

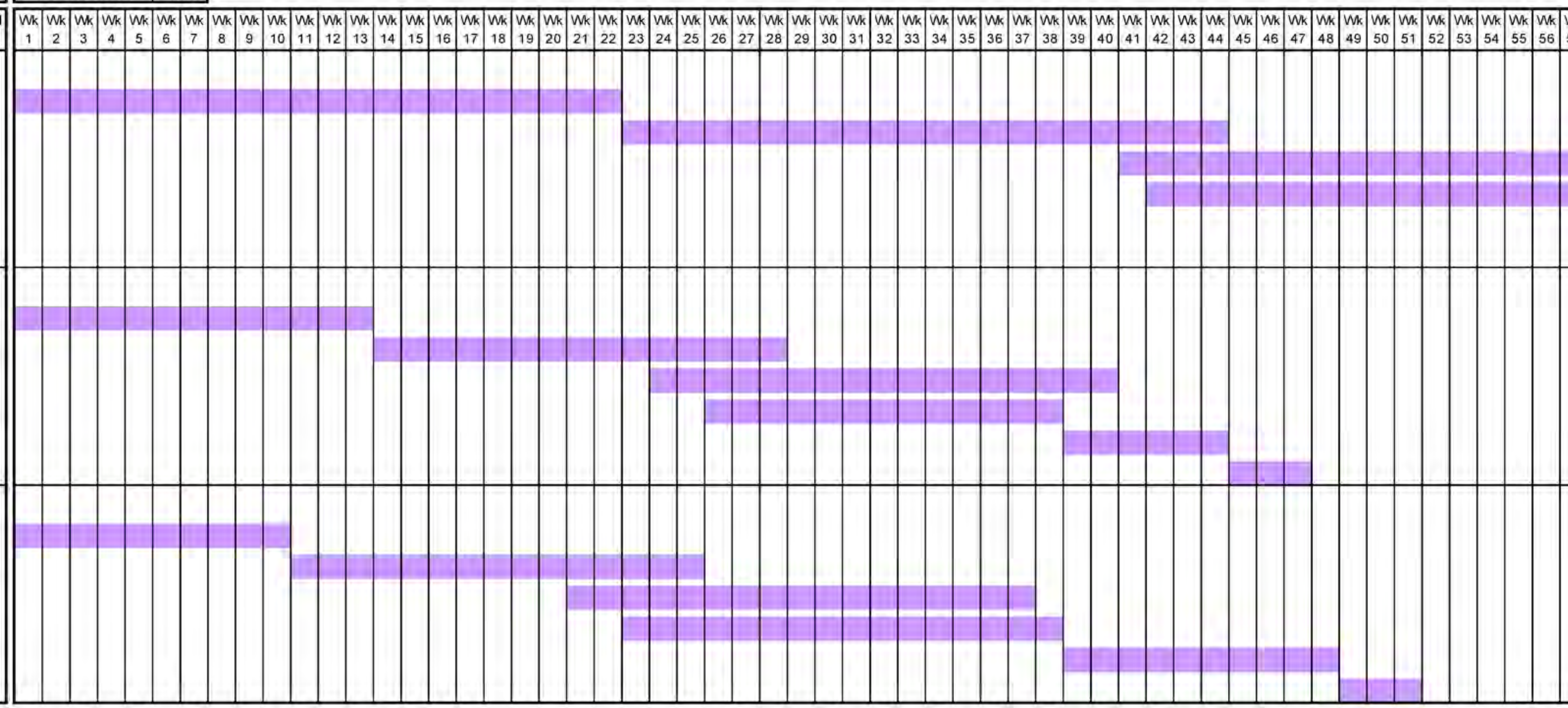
TASK	DURATION (WEEKS)
AC/DC CONVERTER STATION (NEAR IPP)	
SITE GRADING	13
BELOW-GRADE WORK (FOUNDATIONS, CONDUIT, GROUNDING)	32
BUILDING CONSTRUCTION	35
EQUIPMENT INSTALLATION	39
EQUIPMENT TESTING	21
OPERATIONAL	9
500/345 kV AC SUBSTATION (NEAR IPP)	
SITE GRADING	22
BELOW-GRADE WORK (FOUNDATIONS, CONDUIT, GROUNDING)	22
EQUIPMENT INSTALLATION	26
CONTROL BUILDING INSTALLATION	22
EQUIPMENT TESTING	13
OPERATIONAL	7
IPP 345 kV AC SUBSTATION MODIFICATION	
SITE GRADING	13
BELOW-GRADE WORK (FOUNDATIONS, CONDUIT, GROUNDING)	15
EQUIPMENT INSTALLATION	17
CONTROL BUILDING MODIFICATION	13
EQUIPMENT TESTING	7
OPERATIONAL	3
SERIES COMPENSATION STATION	
SITE GRADING	10
BELOW-GRADE WORK (FOUNDATIONS, CONDUIT, GROUNDING)	15
CONTROL HOUSE CONSTRUCTION	17
EQUIPMENT INSTALLATION	16
EQUIPMENT TESTING	10
OPERATIONAL	3



SYSTEM ALTERNATIVE - 3

TOTAL DURATION	82 week

TASK	DURATION (WEEKS)
500/345 kV AC SUBSTATION (NEAR IPP)	
SITE GRADING	22
BELOW-GRADE WORK (FOUNDATIONS, CONDUIT, GROUNDING)	22
EQUIPMENT INSTALLATION	26
CONTROL BUILDING INSTALLATION	22
EQUIPMENT TESTING	13
OPERATIONAL	7
IPP 345 kV AC SUBSTATION MODIFICATION	
SITE GRADING	13
BELOW-GRADE WORK (FOUNDATIONS, CONDUIT, GROUNDING)	15
EQUIPMENT INSTALLATION	17
CONTROL BUILDING MODIFICATION	13
EQUIPMENT TESTING	7
OPERATIONAL	3
SERIES COMPENSATION STATION	
SITE GRADING	10
BELOW-GRADE WORK (FOUNDATIONS, CONDUIT, GROUNDING)	15
CONTROL HOUSE CONSTRUCTION	17
EQUIPMENT INSTALLATION	16
EQUIPMENT TESTING	10
OPERATIONAL	3



SYSTEM ALTERNATIVE - 3		TOTAL DURATION	82 week

TASK	DURATION (WEEKS)	Wk 58	Wk 59	Wk 60	Wk 61	Wk 62	Wk 63	Wk 64	Wk 65	Wk 66	Wk 67	Wk 68	Wk 69	Wk 70	Wk 71	Wk 72	Wk 73	Wk 74	Wk 75	Wk 76	Wk 77	Wk 78	Wk 79	Wk 80	Wk 81	Wk 82	Wk 83	Wk 84	Wk 85
500/345 kV AC SUBSTATION (NEAR IPP)																													
SITE GRADING	22																												
BELOW-GRADE WORK (FOUNDATIONS, CONDUIT, GROUNDING)	22																												
EQUIPMENT INSTALLATION	26																												
CONTROL BUILDING INSTALLATION	22																												
EQUIPMENT TESTING	13																												
OPERATIONAL	7																												
IPP 345 kV AC SUBSTATION MODIFICATION																													
SITE GRADING	13																												
BELOW-GRADE WORK (FOUNDATIONS, CONDUIT, GROUNDING)	15																												
EQUIPMENT INSTALLATION	17																												
CONTROL BUILDING MODIFICATION	13																												
EQUIPMENT TESTING	7																												
OPERATIONAL	3																												
SERIES COMPENSATION STATION																													
SITE GRADING	10																												
BELOW-GRADE WORK (FOUNDATIONS, CONDUIT, GROUNDING)	15																												
CONTROL HOUSE CONSTRUCTION	17																												
EQUIPMENT INSTALLATION	16																												
EQUIPMENT TESTING	10																												
OPERATIONAL	3																												

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FIGURE 32
CONSTRUCTION SCHEDULE FOR SYSTEM ALTERNATIVE 3 SUBSTATION AND SERIES COMPENSATION STATION – SHEET 2

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SECTION 1 - APPROXIMATELY 221 MILES
NORTHERN TERMINAL - NORTHEASTERN UTAH
(NORTHERN TERMINAL - ROUTE SEGMENT U50)

TOTAL DURATION: 122 weeks

TASK	DURATION (WEEKS)
CONSTRUCTION MANAGEMENT / ENGINEERING SUPPORT / ADMINISTRATION	122
INSPECTION	120
MOBILIZE CONTRACTOR	6
RECEIVE / HANDLE MATERIALS	120
SURVEY / STAKE ACCESS ROADS & STRUCTURE PADS	49
CONSTRUCT ACCESS ROADS AND / OR STRUCTURE PADS	49
GEOLOGICAL INVESTIGATIONS	56
SURVEY / STAKE STRUCTURE LOCATIONS	67
EXCAVATE HOLES FOR SELF SUPPORTING LATTICE STRUCTURE	70
INSTALL FOUNDATIONS FOR SELF SUPPORTING LATTICE STRUCTURE	70
HAUL MATERIALS FOR SELF SUPPORTING LATTICE STRUCTURE	60
ASSEMBLE SELF SUPPORTING LATTICE STRUCTURE	66
ERECT SELF SUPPORTING LATTICE STRUCTURE	72
WIRE INSTALLATION	85
FINAL CLEAN UP / RECLAMATION / RESTORATION	70

SECTION 2 - APPROXIMATELY 182 MILES
NORTHEASTERN UTAH - WEST CENTRAL UTAH
(ROUTE SEGMENT U55 - ROUTE SEGMENT U150)

TOTAL DURATION: 124 weeks

TASK	DURATION (WEEKS)
CONSTRUCTION MANAGEMENT / ENGINEERING SUPPORT / ADMINISTRATION	124
INSPECTION	122
MOBILIZE CONTRACTOR	6
RECEIVE / HANDLE MATERIALS	122
SURVEY / STAKE ACCESS ROADS & STRUCTURE PADS	50
CONSTRUCT ACCESS ROADS AND / OR STRUCTURE PADS	50
GEOLOGICAL INVESTIGATIONS	58
SURVEY / STAKE STRUCTURE LOCATIONS	69
EXCAVATE HOLES FOR SELF SUPPORTING LATTICE STRUCTURE	72
INSTALL FOUNDATIONS FOR SELF SUPPORTING LATTICE STRUCTURE	72
HAUL MATERIALS FOR SELF SUPPORTING LATTICE STRUCTURE	63
ASSEMBLE SELF SUPPORTING LATTICE STRUCTURE	68
ERECT SELF SUPPORTING LATTICE STRUCTURE	74
WIRE INSTALLATION	88
FINAL CLEAN UP / RECLAMATION / RESTORATION	72

SECTION 3 - APPROXIMATELY 322 MILES
WEST CENTRAL UTAH - SOUTHERN TERMINAL
(ROUTE SEGMENT U155 - SOUTHERN TERMINAL)

TOTAL DURATION: 140 weeks

TASK	DURATION (WEEKS)
CONSTRUCTION MANAGEMENT / ENGINEERING SUPPORT / ADMINISTRATION	140
INSPECTION	138
MOBILIZE CONTRACTOR	6
RECEIVE / HANDLE MATERIALS	138
SURVEY / STAKE ACCESS ROADS & STRUCTURE PADS	66
CONSTRUCT ACCESS ROADS AND / OR STRUCTURE PADS	66
GEOLOGICAL INVESTIGATIONS	76
SURVEY / STAKE STRUCTURE LOCATIONS	76
EXCAVATE HOLES FOR SELF SUPPORTING LATTICE STRUCTURE	90
INSTALL FOUNDATIONS FOR SELF SUPPORTING LATTICE STRUCTURE	90
HAUL MATERIALS FOR SELF SUPPORTING LATTICE STRUCTURE	83
ASSEMBLE SELF SUPPORTING LATTICE STRUCTURE	83
ERECT SELF SUPPORTING LATTICE STRUCTURE	96
WIRE INSTALLATION	84
FINAL CLEAN UP / RECLAMATION / RESTORATION	96

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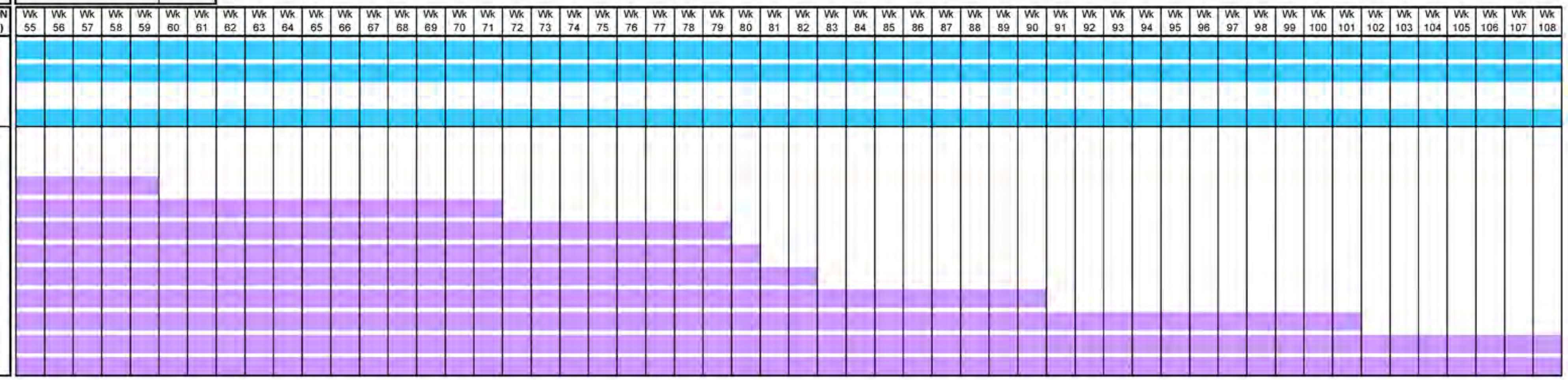
TRANSWEST EXPRESS TRANSMISSION PROJECT
FIGURE 33
CONSTRUCTION SCHEDULE FOR
SYSTEM ALTERNATIVE 3 TRANSMISSION LINE
SHEET 1

SECTION 1 - APPROXIMATELY 221 MILES
NORTHERN TERMINAL - NORTHEASTERN UTAH
(NORTHERN TERMINAL - ROUTE SEGMENT U50)

TOTAL DURATION 111 weeks

TASK	DURATION (WEEKS)
CONSTRUCTION MANAGEMENT / ENGINEERING SUPPORT / ADMINISTRATION	122
INSPECTION	120
MOBILIZE CONTRACTOR	6
RECEIVE / HANDLE MATERIALS	120
SURVEY / STAKE ACCESS ROADS & STRUCTURE PADS	49
CONSTRUCT ACCESS ROADS AND / OR STRUCTURE PADS	49
GEOLOGICAL INVESTIGATIONS	56
SURVEY / STAKE STRUCTURE LOCATIONS	67
EXCAVATE HOLES FOR SELF SUPPORTING LATTICE STRUCTURE	70
INSTALL FOUNDATIONS FOR SELF SUPPORTING LATTICE STRUCTURE	70
HAUL MATERIALS FOR SELF SUPPORTING LATTICE STRUCTURE	60
ASSEMBLE SELF SUPPORTING LATTICE STRUCTURE	66
ERECT SELF SUPPORTING LATTICE STRUCTURE	72
WIRE INSTALLATION	85
FINAL CLEAN UP / RECLAMATION / RESTORATION	70



SECTION 2 - APPROXIMATELY 182 MILES
NORTHEASTERN UTAH - WEST CENTRAL UTAH
(ROUTE SEGMENT U55 - ROUTE SEGMENT U150)

TOTAL DURATION 124 weeks

TASK	DURATION (WEEKS)
CONSTRUCTION MANAGEMENT / ENGINEERING SUPPORT / ADMINISTRATION	124
INSPECTION	122
MOBILIZE CONTRACTOR	6
RECEIVE / HANDLE MATERIALS	122
SURVEY / STAKE ACCESS ROADS & STRUCTURE PADS	50
CONSTRUCT ACCESS ROADS AND / OR STRUCTURE PADS	50
GEOLOGICAL INVESTIGATIONS	58
SURVEY / STAKE STRUCTURE LOCATIONS	69
EXCAVATE HOLES FOR SELF SUPPORTING LATTICE STRUCTURE	72
INSTALL FOUNDATIONS FOR SELF SUPPORTING LATTICE STRUCTURE	72
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ASSEMBLE SELF SUPPORTING LATTICE STRUCTURE	68
ERECT SELF SUPPORTING LATTICE STRUCTURE	74
WIRE INSTALLATION	88
FINAL CLEAN UP / RECLAMATION / RESTORATION	72

SECTION 3 - APPROXIMATELY 322 MILES
WEST CENTRAL UTAH - SOUTHERN TERMINAL
(ROUTE SEGMENT U155 - SOUTHERN TERMINAL)

TOTAL DURATION 140 weeks

TASK	DURATION (WEEKS)
CONSTRUCTION MANAGEMENT / ENGINEERING SUPPORT / ADMINISTRATION	140
INSPECTION	138
MOBILIZE CONTRACTOR	6
RECEIVE / HANDLE MATERIALS	138
SURVEY / STAKE ACCESS ROADS & STRUCTURE PADS	66
CONSTRUCT ACCESS ROADS AND / OR STRUCTURE PADS	66
GEOLOGICAL INVESTIGATIONS	76
SURVEY / STAKE STRUCTURE LOCATIONS	76
EXCAVATE HOLES FOR SELF SUPPORTING LATTICE STRUCTURE	90
INSTALL FOUNDATIONS FOR SELF SUPPORTING LATTICE STRUCTURE	90
HAUL MATERIALS FOR SELF SUPPORTING LATTICE STRUCTURE	83
ASSEMBLE SELF SUPPORTING LATTICE STRUCTURE	83
ERECT SELF SUPPORTING LATTICE STRUCTURE	96
WIRE INSTALLATION	84
FINAL CLEAN UP / RECLAMATION / RESTORATION	96

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TRANSWEST EXPRESS TRANSMISSION PROJECT
FIGURE 33
CONSTRUCTION SCHEDULE FOR SYSTEM ALTERNATIVE 3 TRANSMISSION LINE
SHEET 2

SECTION 1 - APPROXIMATELY 221 MILES
NORTHERN TERMINAL - NORTHEASTERN UTAH
(NORTHERN TERMINAL - ROUTE SEGMENT U50)

TOTAL DURATION: 122 weeks

TASK	DURATION (WEEKS)
CONSTRUCTION MANAGEMENT / ENGINEERING SUPPORT / ADMINISTRATION	122
INSPECTION	120
MOBILIZE CONTRACTOR	6
RECEIVE / HANDLE MATERIALS	120
SURVEY / STAKE ACCESS ROADS & STRUCTURE PADS	49
CONSTRUCT ACCESS ROADS AND / OR STRUCTURE PADS	49
GEOLOGICAL INVESTIGATIONS	56
SURVEY / STAKE STRUCTURE LOCATIONS	67
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HAUL MATERIALS FOR SELF SUPPORTING LATTICE STRUCTURE	60
ASSEMBLE SELF SUPPORTING LATTICE STRUCTURE	66
ERECT SELF SUPPORTING LATTICE STRUCTURE	72
WIRE INSTALLATION	85
FINAL CLEAN UP / RECLAMATION / RESTORATION	70

Wk 109 – Wk 163

SECTION 2 - APPROXIMATELY 182 MILES
NORTHEASTERN UTAH - WEST CENTRAL UTAH
(ROUTE SEGMENT U55 - ROUTE SEGMENT U150)

TOTAL DURATION: 124 weeks

TASK	DURATION (WEEKS)
CONSTRUCTION MANAGEMENT / ENGINEERING SUPPORT / ADMINISTRATION	124
INSPECTION	122
MOBILIZE CONTRACTOR	6
RECEIVE / HANDLE MATERIALS	122
SURVEY / STAKE ACCESS ROADS & STRUCTURE PADS	50
CONSTRUCT ACCESS ROADS AND / OR STRUCTURE PADS	50
GEOLOGICAL INVESTIGATIONS	58
SURVEY / STAKE STRUCTURE LOCATIONS	69
EXCAVATE HOLES FOR SELF SUPPORTING LATTICE STRUCTURE	72
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ASSEMBLE SELF SUPPORTING LATTICE STRUCTURE	68
ERECT SELF SUPPORTING LATTICE STRUCTURE	74
WIRE INSTALLATION	88
FINAL CLEAN UP / RECLAMATION / RESTORATION	72

Wk 109 – Wk 163

SECTION 3 - APPROXIMATELY 322 MILES
WEST CENTRAL UTAH - SOUTHERN TERMINAL
(ROUTE SEGMENT U155 - SOUTHERN TERMINAL)

TOTAL DURATION: 140 weeks

TASK	DURATION (WEEKS)
CONSTRUCTION MANAGEMENT / ENGINEERING SUPPORT / ADMINISTRATION	140
INSPECTION	138
MOBILIZE CONTRACTOR	6
RECEIVE / HANDLE MATERIALS	138
SURVEY / STAKE ACCESS ROADS & STRUCTURE PADS	66
CONSTRUCT ACCESS ROADS AND / OR STRUCTURE PADS	66
GEOLOGICAL INVESTIGATIONS	76
SURVEY / STAKE STRUCTURE LOCATIONS	76
EXCAVATE HOLES FOR SELF SUPPORTING LATTICE STRUCTURE	90
INSTALL FOUNDATIONS FOR SELF SUPPORTING LATTICE STRUCTURE	90
HAUL MATERIALS FOR SELF SUPPORTING LATTICE STRUCTURE	83
ASSEMBLE SELF SUPPORTING LATTICE STRUCTURE	83
ERECT SELF SUPPORTING LATTICE STRUCTURE	96
WIRE INSTALLATION	84
FINAL CLEAN UP / RECLAMATION / RESTORATION	96

Wk 109 – Wk 163

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TRANSWEST EXPRESS TRANSMISSION PROJECT
FIGURE 33
CONSTRUCTION SCHEDULE FOR SYSTEM ALTERNATIVE 3 TRANSMISSION LINE
SHEET 3

4.3.4 Comparison of Proposed TWE Project to System Alternatives

Table 11 provides a comparison summary of System Alternatives 2 and 3 to the proposed TWE Project.

TABLE 11 COMPARISON OF PROPOSED TWE PROJECT TO SYSTEM ALTERNATIVES

COMPARISON FACTORS	PROPOSED TWE PROJECT	SYSTEM ALTERNATIVE 2	SYSTEM ALTERNATIVE 3
TWE Project Configuration	Two-terminal ±600 kV DC transmission line between WY and NV with potential interconnection to IPP system near Delta, UT.	Two terminal ±600 kV DC transmission line between WY and IPP system near Delta, UT. Two terminal single circuit 500 kV AC transmission line between Delta, UT and NV.	Phased Approach Phase 1 – Two terminal 500 kV AC (±600 kV DC) line between WY and IPP near Delta, UT. Phase 2 – proposed TWE Project. Involves building DC line from IPP to Marketplace and two AC/DC converter stations.
Contingencies for System Alternatives	N/A .	Capacity available in the future on IPP STS to serve Desert Southwest.	Capacity available in the future on IPP STS to serve Desert Southwest. The need for transmission capacity requires a phased implementation.
Current Status of System Contingencies and System Alternatives	N/A .	Future available capacity on the IPP STS is uncertain. Therefore, the status of System Alternative 2 is uncertain.	Future available capacity on the IPP STS is uncertain. Currently, all of the TWE Project's 3,000 MW of capacity is needed by the projected in-service date. It is unlikely System Alternative 3 will be pursued.

TABLE 11 COMPARISON OF PROPOSED TWE PROJECT TO SYSTEM ALTERNATIVES			
COMPARISON FACTORS	PROPOSED TWE PROJECT	SYSTEM ALTERNATIVE 2	SYSTEM ALTERNATIVE 3
Routing Alternatives	As part of the EIS preparation, the BLM and Western have established three regions for the TWE Project route. Each region has a distinct set of Route Alternatives.	The TWE Project route region and all Route Alternatives for each region all apply to System Alternative 2.	The TWE Project route region and all Route Alternatives for each region all apply to System Alternative 3.
System Capacity	3,000 MW between WY and NV	3,000 MW between WY and UT 1,500 MW between UT and NV	Phase 1 - 1,500 MW between WY and UT Phase 2 - 3,000 MW between WY and NV
Typical Transmission Line Towers Used	Guyed or self supporting lattice towers holding up <u>two conductor bundles</u> for entire Project.	Guyed or self supporting lattice towers holding up <u>two conductor bundles</u> between WY and Delta, UT. Guyed or self supporting lattice towers holding up <u>three conductor bundles</u> between Delta, UT and NV.	Guyed or self supporting lattice towers holding up <u>three conductor bundles</u> between WY and Delta, UT. Guyed or self supporting lattice towers holding up <u>two conductor bundles</u> between Delta, UT and NV.
Terminals - AC/DC Converter Stations	Northern Terminal near Sinclair, WY. Southern Terminal at Marketplace Hub near Boulder City, NV.	Northern Terminal same as proposed TWE Project. Southern Terminal near the IPP near Delta, UT.	Phase 1 – no AC/DC Converter Stations Phase 2 - Same as proposed TWE Project.

TABLE 11 COMPARISON OF PROPOSED TWE PROJECT TO SYSTEM ALTERNATIVES			
COMPARISON FACTORS	PROPOSED TWE PROJECT	SYSTEM ALTERNATIVE 2	SYSTEM ALTERNATIVE 3
TWE Project Interconnections	Northern Terminal will interconnect with existing 230 kV line and one (two total) 500 kV circuit of the Energy Gateway West and Energy Gateway South projects. Southern Terminal will interconnect with the existing 500 kV AC substations (up to 4 total) at the Marketplace Hub near Boulder City, NV. Potential interconnection with IPP system near Delta, UT.	Same as proposed TWE Project for Northern Terminal. Southern Terminal would be located near Delta, UT and would be interconnected to the IPP transmission system, and the TWE Project 500 kV AC line. The TWE Project 500 kV AC line would interconnect with one of the existing 500 kV AC substations at the Marketplace Hub near Boulder City, NV.	Phase 1 – The TWE Project 500 kV AC line would interconnect with the existing 230 kV line and the 500 kV Energy Gateway West and Energy Gateway South lines in WY and with the IPP Substation near Delta, UT. Phase 2 – same as the proposed TWE Project.
Related Structures and Facilities	Fiber optic network communications system. Two ground electrode facilities near terminals.	Same as the proposed TWE Project, however, ground electrode facility would be within 50 miles of the Southern Terminal near IPP Substation, Delta, UT.	Phase 1 – Fiber optic network communications system between WY and NV. No ground electrode. Phase 2 - Same as proposed TWE Project.

4.4 Underground Alternatives

Underground cable systems have been considered and evaluated for the TWE Project. To date, underground cable technology is not commercially available at the very high voltage and capacity levels (i.e., 600 kV and 3,000 MW) required to meet the TWE Project's purpose and need. The technology is not presently available, nor is it likely that it will become available within the time frame for the construction of the Project. The Applicant is committed to using the latest and most applicable commercially available technology. While there are theoretical and laboratory experiments in place that could conceivably be applied to the voltage and capacity levels of the TWE Project, there are no AC or DC underground installations worldwide above 500 kV or 2,000 MW either in-service or planned to be in-service in the next decade.

Advancements have been made in underground technology, however, sufficient testing or installation data for a ±600 kV, 3,000 MW underground application is not currently available. The Applicant will continue to consider and evaluate the technical and commercial feasibility of underground technologies for the TWE Project, however advancements in the technology to make undergrounding any portion of the Project feasible is not likely.

Below is a brief description of the various technologies, including information on the voltage levels that have been achieved for underground and submarine systems in service and advancements under development.

4.4.1 Underground Cable System Technologies

Self Contained Fluid Filled Cable - Self-contained fluid filled (SCFF) cable systems are typically constructed around a hollow tube, used for fluid circulation, and use Kraft paper insulation or a laminated polypropylene paper (LPP) insulation that is impregnated with dielectric fluid to minimize the insulation breakdown under electrical stress. To maintain pressure within the system, pumping plants are required every seven to ten miles along the route, assuming a relatively flat topography. The pumping plants are responsible for maintaining a constant pressure on the system, but must have large reserve tanks to facilitate the expansion and contraction of the dielectric fluid as the system undergoes thermal cycling.

While SCFF cable systems have the longest running history at the EHV levels, their use is typically restrained to long submarine cable installations. However, this technology has been implemented on inland applications with high reliability at voltages up to ±450 kV DC. Installations above this level do not exist worldwide.

Mass Impregnated – Mass impregnated (MI) cable systems account for nearly 80% of the worldwide long distance DC submarine installations. Constructed with ether Kraft paper or LPP insulation that is impregnated with a dielectric fluid, MI cables are similar to SCFF systems except fluid pumping facilities are not required. By reducing the number of system components, it can be argued that MI cable systems are more reliable than their SCFF counterparts and this conclusion if generally supported by a long running reliability track record. To date, ±500 kV DC is the highest voltage system in operation worldwide.

Cross Linked Polyethylene - Cross linked polyethylene (XLPE) cable systems are the most advanced solid dielectric cables found within the industry. Currently ±150 kV DC is the highest rated cable system in the world, however design and installation of a ±320 kV DC system is presently underway. The use of HVDC solid dielectric cable has been delayed due primarily to complications with the XLPE insulation. The main concern with XLPE insulation is the buildup of space charges in the insulation and their subsequent distortion of the electrical stress distribution. Recent progress in the development of a modified XLPE insulation has apparently been successful in solving the space-charge problem, and the Japanese have prepared an International Council on Large Electric Systems paper documenting testing of a XLPE cable up to ±500 kV with satisfactory results.

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APPENDICES

APPENDIX A

TWE PROJECT COMPONENTS DISTURBANCE AND ACCESS ROAD METHODOLOGY

TWE Project Components Disturbance Methodology

The typical design characteristics of the TWE Project components shown in Table 1 were used to develop Excel spreadsheets that calculated the temporary and permanent land disturbance resulting from the TWE Project + 600 kV transmission line, terminals, ground electrodes, and system alternatives. For the transmission line component, disturbances were calculated for each alternative route segment so that any combination of these segments could be used to analyze impacts of alternative routes. The transmission line and terminal disturbance spreadsheets were modified as appropriate for each system alternative.

TABLE A-1 TWE PROJECT COMPONENTS DESIGN CHARACTERISTICS USED IN DISTURBANCE ESTIMATES	
± 600 KV DC TRANSMISSION LINE	
Physical Properties	
Line Length	Miles per route segment
Structure Type[14]	Self supporting steel lattice
Span Length	900 to 1,500 feet
Number of Structures per Mile	Approximately four
ROW Width	250 feet
Land Temporarily Disturbed	
Structure Work Area	ROW width (250 ft) x 200 feet per structure
Wire-Pulling, Tensioning and Splicing Sites	ROW width (250 ft) x 500 feet for dead-end structure (two sites at every dead-end structures) ROW width (250 ft) x 500 feet for mid-span conductor and shield wire (approximately every 9,000 feet) 100 x 500 feet for fiber optic cable set-up sites (approximately every 18,000 feet)
Material Storage Yards	20 acres every 30 miles of line
Staging Areas / Fly Yards	7 acres every 5 miles of line
Batch Plant Sites	5 acres every 15 miles of line
Land Permanently Disturbed	
Structure Base	Self Supporting Lattice (tangent) - 900 square feet (30 x 30 feet tower base) Self Supporting Lattice (angle) - 1,225 square feet (35 x 35 feet tower base) Self Supporting Lattice (dead-end) - 1,600 square feet (40 x 40 feet tower base)
Regeneration Sites	10,000 square feet (100 x 100 feet) every 50 miles of line
New Access Roads	See Section 3.5.2.1 Access Road Construction and Appendix A Access Road Methodology
NORTHERN AND SOUTHERN TERMINALS	
Physical Properties of Interconnection Lines	

[14] Tangent self supporting lattice structures were used to calculate disturbance since this structure type would result in greater disturbances per structure than the proposed guyed lattice structure. Structure types to be used in site-specific settings will be determined during engineering and design of the Agency Preferred Alternative.

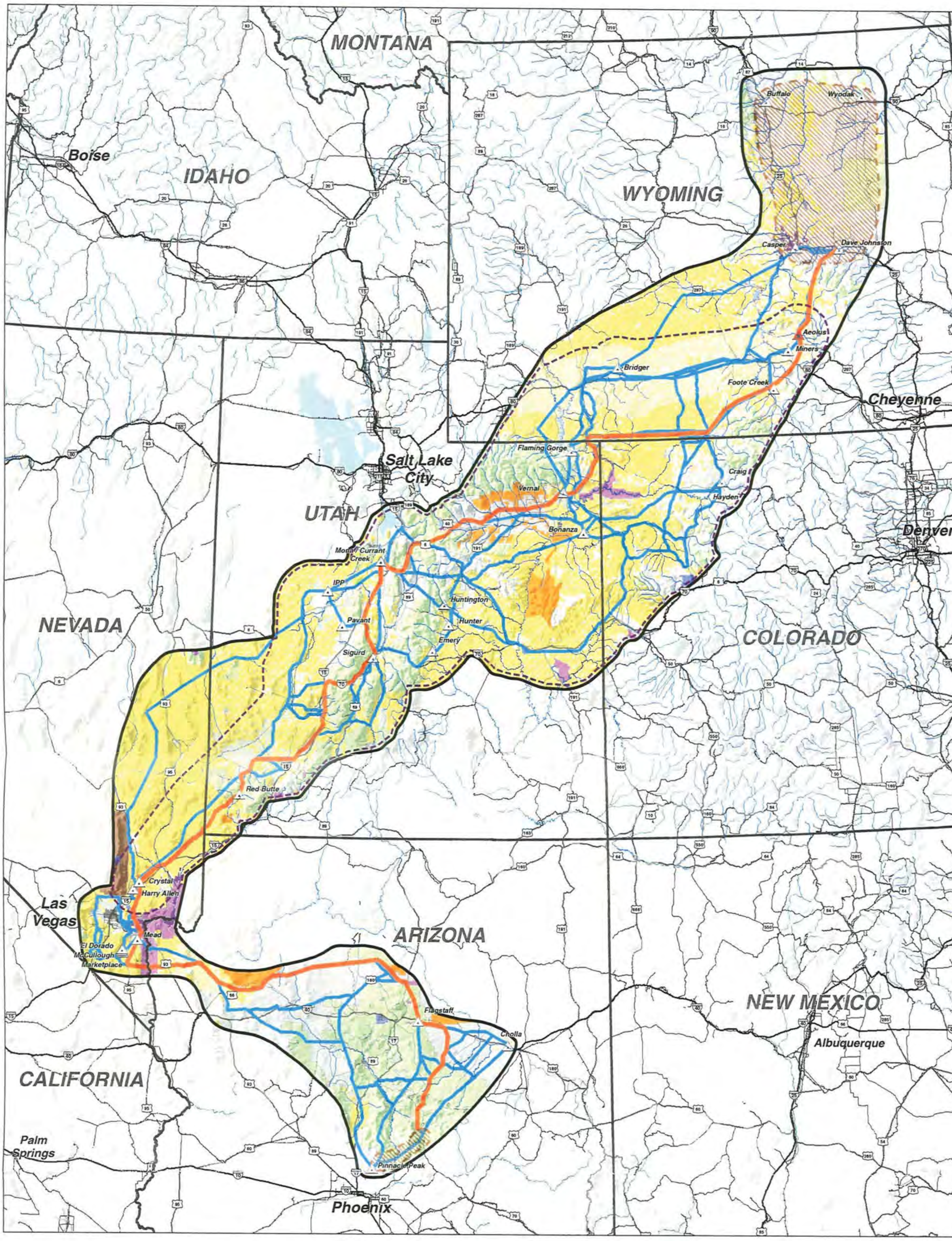
TABLE A-1 TWE PROJECT COMPONENTS DESIGN CHARACTERISTICS USED IN DISTURBANCE ESTIMATES	
Line Length	Miles per interconnection line
Structure Type	Self supporting steel lattice for 500 kV line Single pole tubular steel for 230 kV line
Number of Structures per Mile	Approximately six (230 kV structure) and four (500 kV structure)
ROW Width	100 feet for 230 kV line 250 feet for 500 kV line
Land Temporarily Disturbed	
Storage and Concrete Batch Plant	7.5 acres
Structure Work Areas for Interconnection Lines	200 x 200 feet per 230 kV structure; approximately 6 per mile of line (N. Terminal only) 250 x 200 feet per 500 kV structure; approximately 4 per mile of line
Wire-Pulling, Tensioning and Splicing Sites for Interconnection Lines	ROW width x 500 feet – mid-span conductor and shield wire sites every 9,000 feet and fiber optic set-up sites every 18,000 feet
Land Permanently Disturbed	
Converter Station and Switchyards	205 acres (N. Terminal), 140 acres (S. Terminal)
Structure Base 500 kV Interconnection Line	Self Supporting Lattice (tangent) – 1,225 square feet (35 x 35 feet tower base) Self Supporting Lattice (angle) - 1,600 square feet (40 x 40 feet tower base) Self Supporting Lattice (dead-end) – 2,025 square feet (45 x 45 feet tower base)
Structure Base 230 kV Interconnection Line	Single Pole Tubular (tangent) - 40 square feet Single Pole Tubular (angle) - 45 square feet Single Pole Tubular (dead-end) – 50 square feet
New Access Roads	See Section 3.5.2.1 Access Road Construction and Appendix A Access Road Methodology
GROUND ELECTRODES	
Physical Properties of Overhead Electrode Lines	
Line Length	Miles per electrode line
Structure Type	Wood poles for low voltage 34.5 kV line
Number of Structures per Mile	18
ROW Width	50 feet
Land Temporarily Disturbed	
Ground Electrode Site	65 acres
Material Storage Yards	10 acres (one at each electrode site)
Structure Work Areas for 34.5 kV Line	ROW (50 ft) x 100 feet
Wire-Pulling, Tensioning and Splicing Sites for Interconnection Lines	75 x 150 feet – two at every dead-end 75 x 100 feet – mid-span conductor site every 9,000 feet
Land Permanently Disturbed	
Ground Electrode Site	0.5 acres
Well Access	5 acres

TABLE A-1 TWE PROJECT COMPONENTS DESIGN CHARACTERISTICS USED IN DISTURBANCE ESTIMATES	
Structure Base 34.5 kV Line	Wood pole (tangent) - 16 square feet Wood pole (angle) - 25 square feet plus 25 square feet per anchor (2 per structure location) Wood pole (dead-end) – 36 square feet plus 25 square feet per anchor (4 per structure location)
New Access Roads	See Section 3.5.2.1 Access Road Construction and Appendix A Access Road Methodology

APPENDIX B

Supplemental Map Exhibits B-1 to B-6

- B-1 Preliminary Right-of-Way Application Corridors, November 2007.
- B-2 Proposed and Alternative Routes, Amended SF-299 Application, December 2008.
- B-3 Proposed and Alternative Routes, Las Vegas Area, Amended SF-299 Application, December 2008.
- B-4 Proposed and Alternative Routes, Amended SF-299 Application, January 2010.
- B-5 Proposed and Alternative Routes, Las Vegas Area, Amended SF-299 Application, January 2010.
- B-6 Proposed and Alternative Corridors, Amended POD, July 2010.



Data Sources

Land Ownership:
BLM Denver Service Center, 2006
BLM - National Atlas, 2006, EPG Inc, 2007

NOTE: Substation locations are schematics and do not necessarily represent precise locations. Preliminary transmission line corridors generally follow existing or planned transmission lines; however, the existing transmission lines are not depicted on the map for graphical clarity.

Figure 5

Preliminary Right-Of-Way Application Corridors

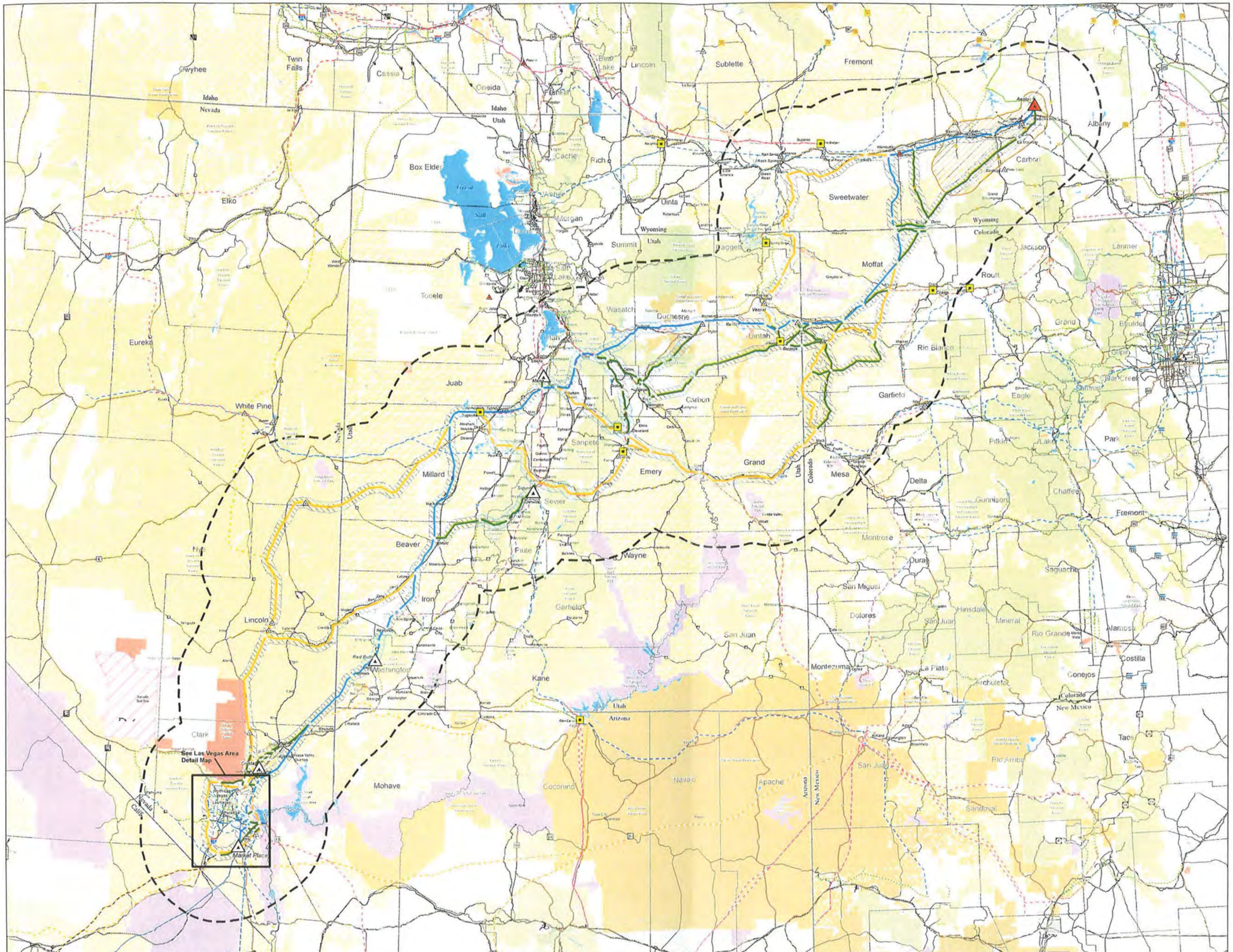
TransWest Express Transmission Project

nationalgrid APS ROCKY MOUNTAIN POWER

Working Draft: November 30, 2007

N:\projects\nationalgrid\gateway\corridor_analysis\mxds\basemap.mxd

FIGURE 1
PROPOSED AND ALTERNATIVE ROUTES



Legend

Land Jurisdiction

- Bureau of Land Management
- Indian Reservation
- U.S. Forest Service
- National Park Service
- U.S. Fish & Wildlife Service
- Department of Defense
- Bureau of Reclamation
- Department of Energy
- State Land
- Private Land

Project Features

- Proposed Substation (Permitting in Progress)
- Study Area Boundary
- Proposed Route
- Proposed Alternative Route
- Alternatives Under Further Consideration
- 6 Mile Wide Corridor Buffer
- Link Node
- Terminal Siting Area

Utility Facilities

- Existing Power Plant
- Existing Substation
- 500kV+/- DC Transmission Line
- 500kV Transmission Line
- 345kV Transmission Line
- 230kV Transmission Line
- 115/138kV Transmission Line

Transportation Features

- Interstate Highway
- US Highway
- State Highway
- Railroad

Water Features

- River or Stream
- Lake, Pond, or Reservoir

Data Sources

Transportation:
NTAD2008, US Department of Transportation
Land Jurisdiction:
BLM State Office California, Colorado, Idaho, New Mexico, Oregon, Utah, Wyoming 2008
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NOTE: Substation locations are schematic and do not necessarily represent precise locations.

Print Date December 12, 2008

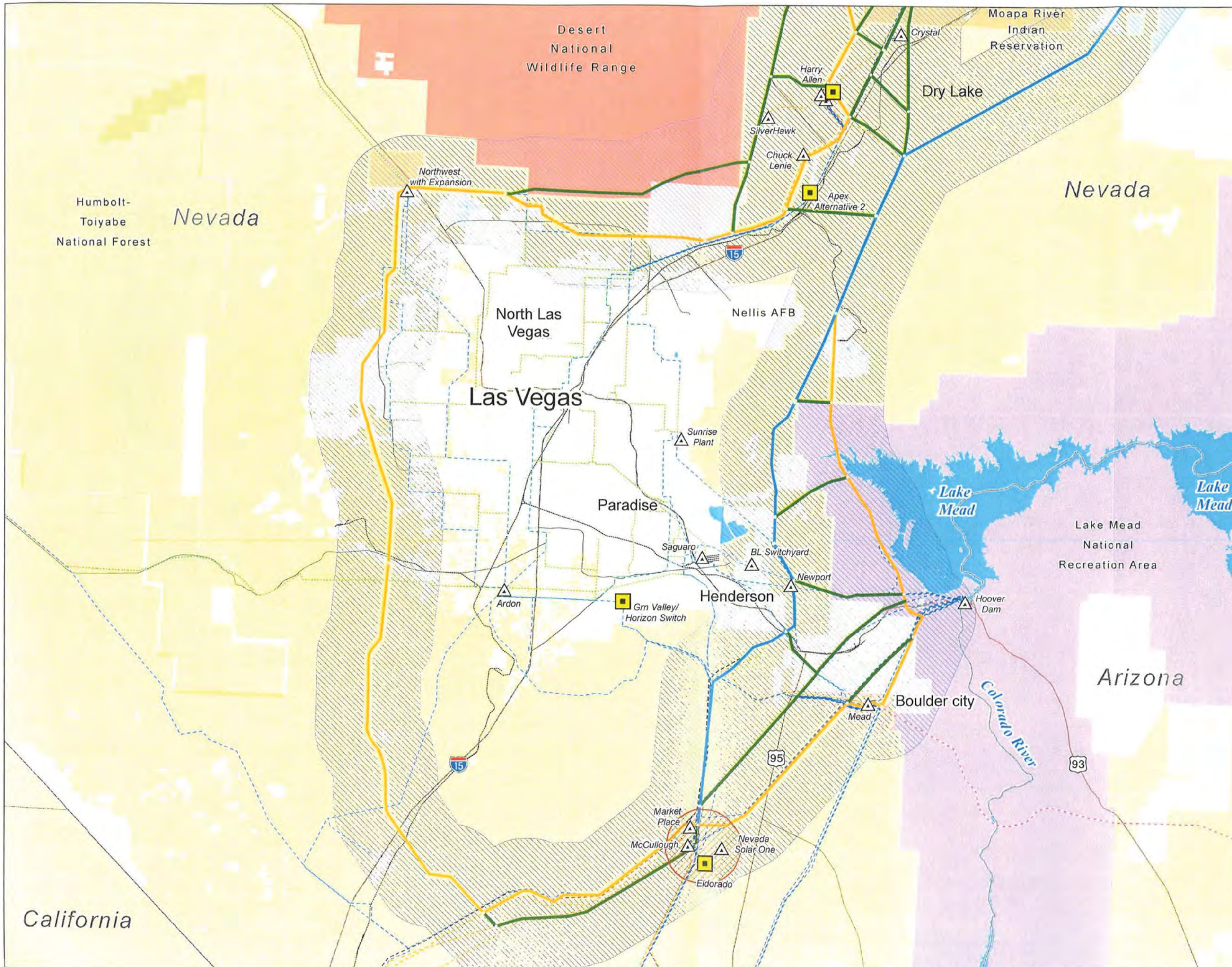
DRAFT

0 12.5 25 50 75 100 Miles

TRANSWEST EXPRESS TRANSMISSION LINE PROJECT

TRANSWEST EXPRESS LLC

FIGURE 2
PROPOSED AND ALTERNATIVE ROUTES LAS VEGAS AREA



Legend

Land Jurisdiction

- Bureau of Land Management
- Indian Reservation
- U.S. Forest Service
- National Park Service
- U.S. Fish & Wildlife Service
- Department of Defense
- Bureau of Reclamation
- Department of Energy
- State Land
- Private Land

Project Features

- Proposed Route
- Proposed Alternative Route
- Alternatives Under Further Consideration
- 6 Mile Wide Corridor Buffer
- Link Node
- Terminal Siting Area

Utility Facilities

- Existing Power Plant
- Existing Substation
- 500kV+/- DC Transmission Line
- 500kV Transmission Line
- 345kV Transmission Line
- 230kV Transmission Line
- 115/138kV Transmission Line

Transportation Features

- Interstate Highway
- US Highway
- State Highway
- Railroad

Water Features

- River or Stream
- Lake, Pond, or Reservoir

Data Sources

Transportation:
NTAD2008, US Department of Transportation
Land Jurisdiction:
BLM State Office California, Colorado, Idaho, New Mexico, Oregon, Utah, Wyoming 2008
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NOTE: Substation locations are schematic and do not necessarily represent precise locations.

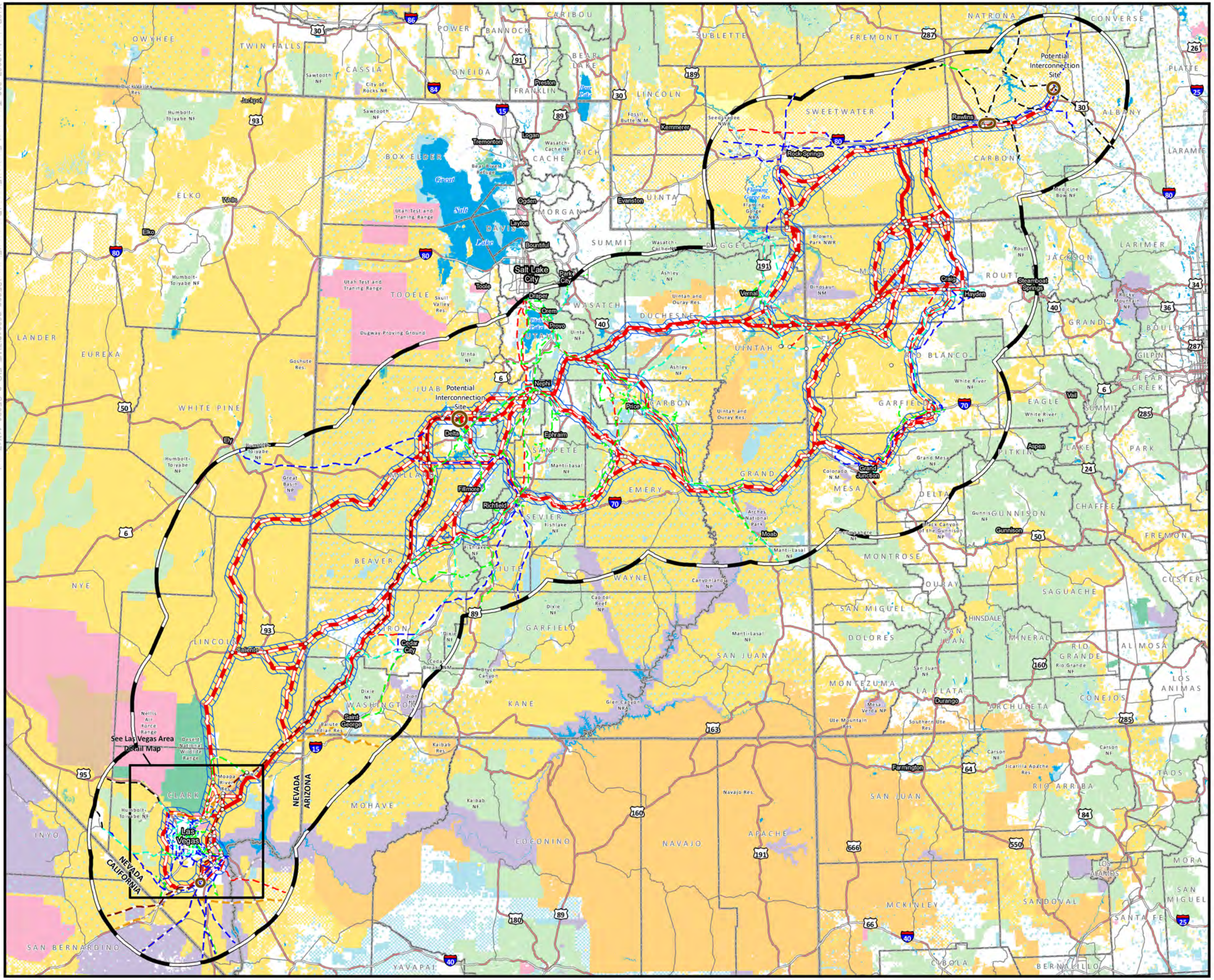
Print Date December 12, 2008

DRAFT

0 1.25 2.5 5 7.5 10 Miles

TRANSWEST EXPRESS TRANSMISSION LINE PROJECT

TRANSWEST EXPRESS LLC



MAP EXHIBIT B-4
PROPOSED AND ALTERNATIVE ROUTES

Legend

Project Features
- Proposed Route
- Proposed Alternatives
- Link Node
- 6-Mile-Wide Corridor
- Study Area
- Terminal Siting Area

Utility Facilities
- 500kV +/- Direct Current Transmission Line
- 500kV Transmission Line
- 345kV Transmission Line
- 230 to 287kV Transmission Line
- 138 to 161kV Transmission Line
- 115kV Transmission Line
- Below 100kV Transmission Line
- Unknown Voltage Transmission Line

Transportation Features
- Interstate Highway
- U.S. Highway
- State Highway

Water Features
- Perennial Water Bodies

Land Jurisdiction
- Department of Defense
- Department of Energy
- Indian Reservation
- State Land
- USDA Forest Service
- USDI Bureau of Land Management
- USDI Bureau of Reclamation
- USDI Fish and Wildlife Service
- USDI National Park Service

Data Sources

Transportation:
NTAD2008, US Department of Transportation
Land Jurisdiction:
BLM State Office California, Colorado, Idaho, New Mexico, Oregon, Utah, Wyoming 2008
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Print Date : January 22, 2010

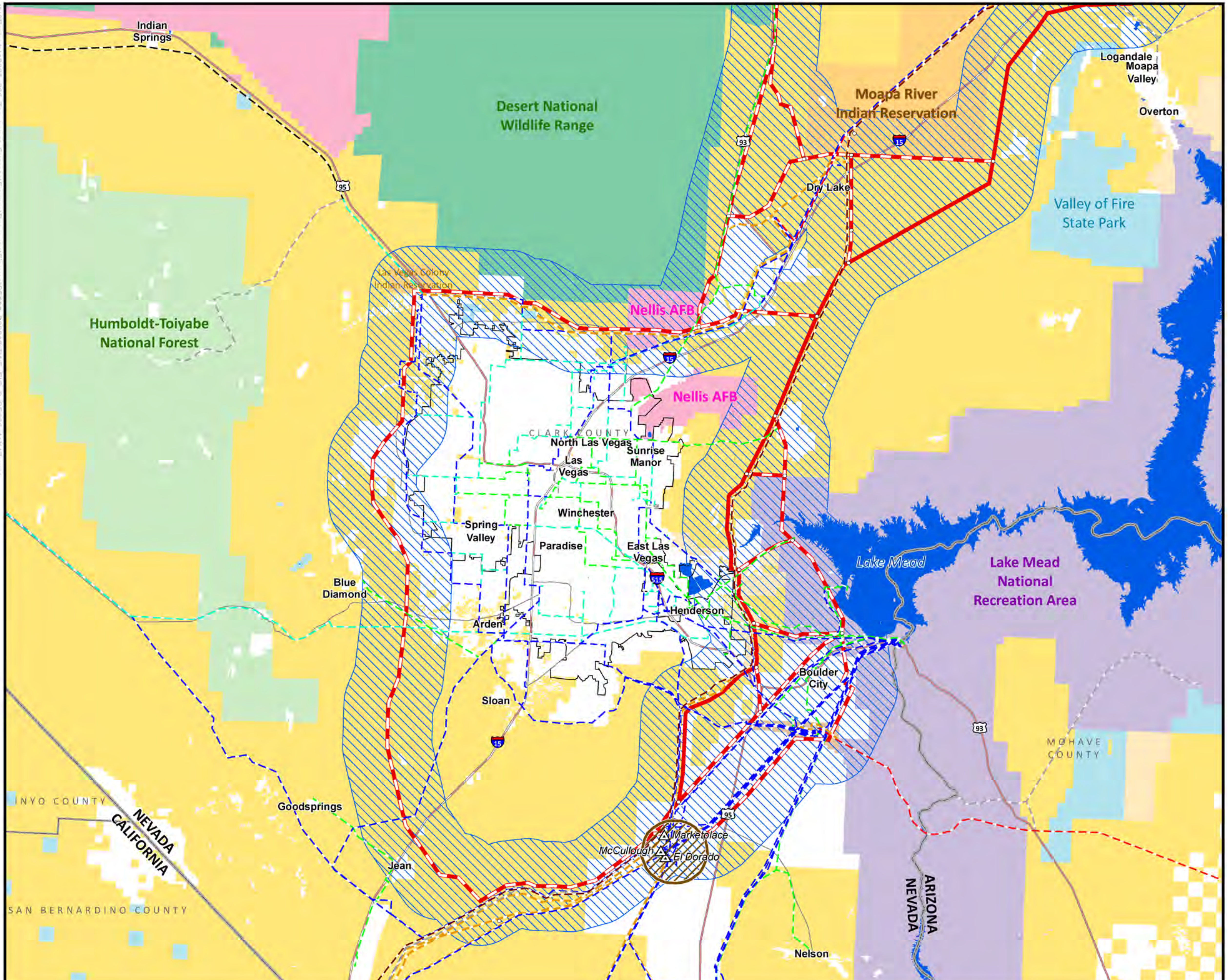
0 20 40 80 120
Miles

TRANSWEST EXPRESS TRANSMISSION PROJECT

NATIONAL SYSTEM OF PUBLIC LANDS

TRANSWEST EXPRESS LLC

MAP EXHIBIT B-5
PROPOSED AND ALTERNATIVE ROUTES LAS VEGAS AREA



Legend

Project Features
- Proposed Route
- Proposed Alternatives
- Link Node
- 6-Mile-Wide Corridor
- Study Area
- Terminal Siting Area

Utility Facilities
- Project Substation
- 500kV +/- Direct Current Transmission Line
- 500kV Transmission Line
- 345kV Transmission Line
- 230 to 287kV Transmission Line
- 138 to 161kV Transmission Line
- 115kV Transmission Line
- Below 100kV Transmission Line
- Unknown Voltage Transmission Line

Transportation Features
- Interstate Highway
- U.S. Highway
- State Highway

Water Features
- Perennial Water Bodies

Land Jurisdiction
- Department of Defense
- Department of Energy
- Indian Reservation
- State Land
- USDA Forest Service
- USDI Bureau of Land Management
- USDI Bureau of Reclamation
- USDI Fish and Wildlife Service
- USDI National Park Service

Data Sources

Transportation:
NTAD2008, US Department of Transportation
Land Jurisdiction:
BLM State Office California, Colorado, Idaho, New Mexico, Oregon, Utah, Wyoming 2008
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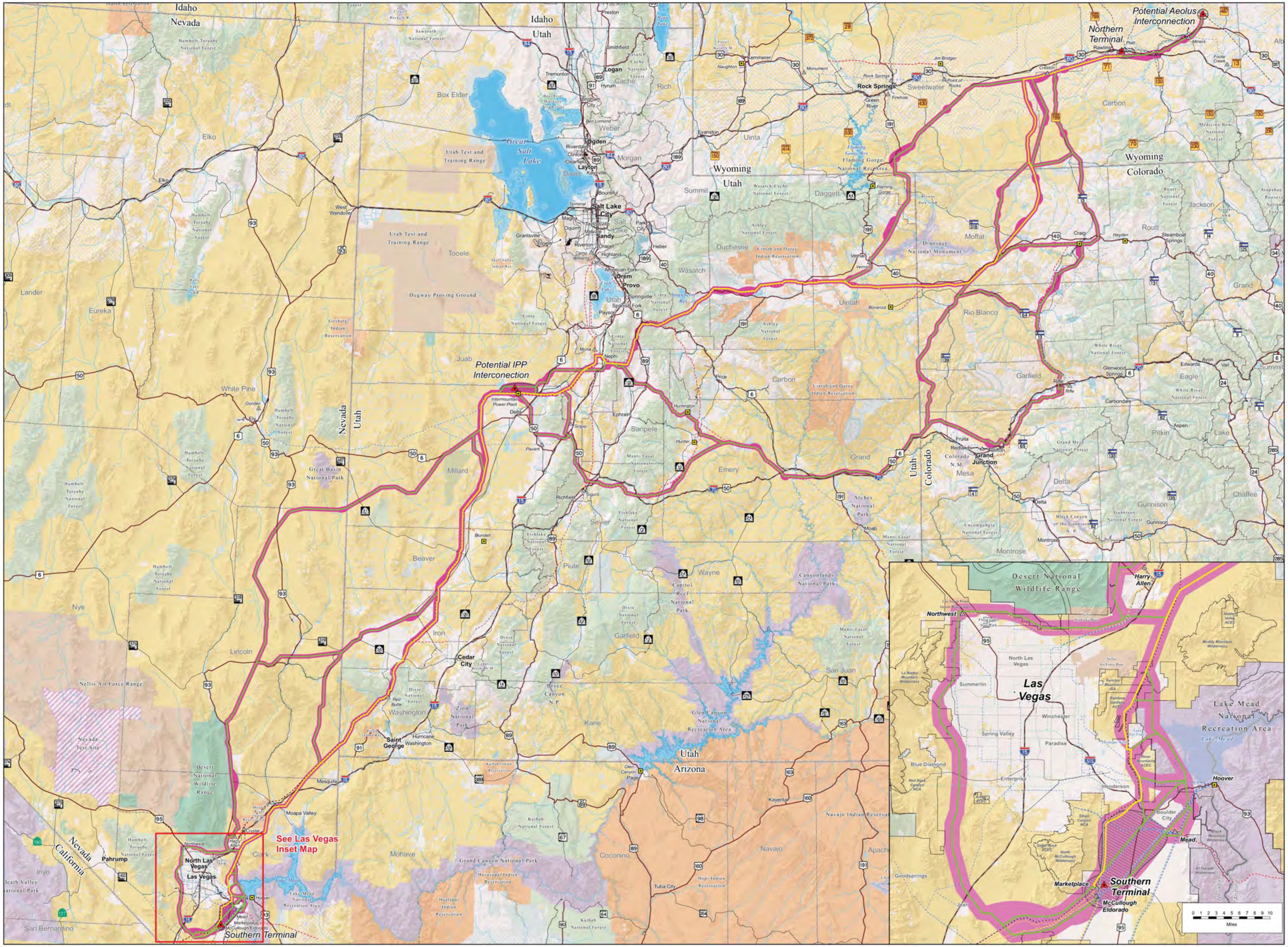
Print Date : January 22, 2010

0 2.5 5 10 15
Miles

TRANSWEST EXPRESS TRANSMISSION PROJECT

NATIONAL SYSTEM OF PUBLIC LANDS

TRANSWEST EXPRESS LLC



MAP EXHIBIT B-6
PROPOSED AND ALTERNATIVE CORRIDORS

Legend

Project Features

- Proposed Segment
- Alternative Segment
- Proposed & Alternative Corridors (Typical two miles wide)
- Proposed Substation/ Terminal
- Terminal Siting Area

Land Jurisdiction

- Department of Defense
- Department of Energy
- Indian Reservation
- USDA Forest Service
- USDI Bureau of Land Management
- USDI Bureau of Reclamation
- USDI Fish and Wildlife Service
- USDI National Park Service
- State Land
- State or Local Park
- Private Land

Existing Utilities

- Existing Power Plant
- Existing Substation
- 500kV+/- DC Transmission Line
- 500kV Transmission Line
- 345kV Transmission Line
- 230 to 287kV Transmission Line
- 138 to 161kV Transmission Line
- 115kV Transmission Line

Transportation Features

- Interstate Highway
- US Highway
- State Highway
- Railroad

Water Features

- River or Stream
- Lake, Pond, or Reservoir

Data Sources

Transportation:
NTAD2008, US Department of Transportation
Land Jurisdiction:
BLM State Office California, Colorado, Idaho, New Mexico, Oregon, Utah, Wyoming 2008
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NOTE: Substation locations are schematic and do not necessarily represent precise locations.

Date updated: June 29, 2010
Routes Current as of June 23, 2010

The routes shown on this map are preliminary and may be revised and/or refined throughout the development of the project.

0 10 20 30 40 50 60 70 80
Miles
1:800,000

TRANSWEST EXPRESS TRANSMISSION PROJECT

POWER ENGINEERS
June 29, 2010

TRANSWEST EXPRESS LLC

APPENDIX C

Supplemental Information – TWE Project Vegetation Management Program

- Table C-1 TWE Project DEIS Vegetation Management Guidelines by Vegetation-Land Cover Type - Response to AECOM December 10, 2010 Data Request Number 1.5
- Figure C-1 Figure C-1 Photographs of Level 3 Vegetation Management

TABLE C-1 TWE PROJECT DEIS VEGETATION MANGEMENT GUIDELINES BY VEGETATION LAND COVER TYPE RESPONSE TO AECOM DECEMBER 10, 2010 DATA REQUEST NUMBER 15					
VEGETATION LAND COVER TYPE/ AND DOMINANT SPECIES*	HEIGHT RANGE	REGENERATION TIME TO FORMER HEIGHT (YEARS)	LEVEL 1 – STANDARD ROW VEGETATION MANAGEMENT	LEVEL 2 – SELECTIVE ROW VEGETATION MANAGEMENT – WIRE-BORDER ZONE	LEVEL 3 – SELECTIVE ROW – CLEARANCE BASED VEGETATION MANAGEMENT
Montane Forest SO28, SO32 - Douglas fir - Subalpine fir - Engelmann spruce - Aspen	60 to 80 feet	50 to 150 years	Construction Phase: Cleared from ROW. Operation Phase: ROW managed for low growing shrubs and herbs.	Construction Phase: *<u>ROW Wire Zone</u>* – Same as Level 1. Cleared from ROW *<u>ROW Border Zone</u>* - Selectively cleared based on allowed vegetation types, heights and densities. Operation Phase: *<u>ROW Wire Zone -</u>* Same as Level 1. Managed for low growing shrubs and herbs. *<u>ROW Border Zone</u>* – managed for compatible vegetation types, heights and densities, including trees, shrubs and herbs, based on allowed types, heights and densities.	Construction Phase: *<u>ROW Wire Zone -</u>* Selectively cleared based on allowed vegetation types, heights and densities. *<u>ROW Border Zone -</u>* Selectively cleared based on allowed vegetation types, heights and densities. Operation Phase: *<u>ROW Wire Zone -</u>* Managed for compatible vegetation, including trees, shrubs and herbs, based on allowed types, heights and densities. *<u>ROW Border Zone –</u>* Managed for compatible vegetation, including trees, shrubs and herbs, based on allowed types, heights and densities.
Aspen SO 23	30 to 70 feet	30 to 60 years	Construction Phase: Cleared from ROW. Operation Phase: ROW managed for low growing shrubs and herbs.	Construction Phase: *<u>ROW Wire Zone</u>* – Same as Level 1. Cleared from ROW *<u>ROW Border Zone</u>* – Same	Construction Phase: *<u>ROW Wire Zone -</u>* Selectively cleared based on allowed heights and densities.

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VEGETATION LAND COVER TYPE/ AND DOMINANT SPECIES*	HEIGHT RANGE	REGENERATION TIME TO FORMER HEIGHT (YEARS)	LEVEL 1 – STANDARD ROW VEGETATION MANAGEMENT	LEVEL 2 – SELECTIVE ROW VEGETATION MANAGEMENT – WIRE-BORDER ZONE	LEVEL 3 – SELECTIVE ROW – CLEARANCE BASED VEGETATION MANAGEMENT
				as Level 1. Cleared from ROW. Operation Phase: *ROW Wire Zone -* Same as Level 1. Managed for low growing shrubs and herbs. *ROW Border Zone* – managed for allowed tree heights and densities.	*ROW Border Zone -* Selectively cleared based on allowed heights and densities. Operation Phase: *ROW Wire Zone -* Managed for allowed vegetation, including shrub and types, heights and densities. *ROW Border Zone –* Managed for allowed vegetation, including shrub and tree types, heights and densities.
Ponderosa Pine SO36	40 to 90 feet	30 to 100 years	Construction Phase: Cleared from ROW. Operation Phase: ROW managed for low growing shrubs and herbs.	Construction Phase: *ROW Wire Zone* – Same as Level 1. Cleared from ROW *ROW Border Zone* - Selectively cleared based on allowed vegetation types, heights and densities. Operation Phase: *ROW Wire Zone -* Same as Level 1. Managed for low	Construction Phase: *ROW Wire Zone -* Selectively cleared based on allowed heights and densities. *ROW Border Zone -* Selectively cleared based on allowed heights and densities. Operation Phase:

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				growing shrubs and herbs. <u>*ROW Border Zone*</u> – managed for allowed tree heights and densities.	<u>*ROW Wire Zone -*</u> Managed for allowed vegetation, including shrub and types, heights and densities. <u>*ROW Border Zone –*</u> Managed for allowed vegetation, including shrub and tree types, heights and densities.
Pinyon Juniper SO39, SO40, SO52 - Pinyon pine Utah Juniper	15 to 40 feet	100 to 300 years	Construction Phase: Cleared from ROW. Operation Phase: ROW managed for low growing shrubs and herbs.	Construction Phase: <u>*ROW Wire Zone*</u> – Same as Level 1. Cleared from ROW <u>*ROW Border Zone*</u> - Selectively cleared based on allowed heights and densities. Most pinyon juniper would be allowed in the border zone. Operation Phase: <u>*ROW Wire Zone -*</u> Same as Level 1. Managed for low growing shrubs and herbs. <u>*ROW Border Zone*</u> – managed for allowed tree heights and densities.	Construction Phase: <u>*ROW Wire Zone -*</u> Selectively cleared based on allowed heights and densities. Most pinyon juniper would be allowed in the wire zone. <u>*ROW Border Zone -*</u> Selectively cleared based on allowed heights and densities. Most pinyon juniper would be allowed in the border zone. Operation Phase: <u>*ROW Wire Zone -*</u> Managed for allowed vegetation, including shrub and tree types, heights and densities.

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VEGETATION LAND COVER TYPE/ AND DOMINANT SPECIES*	HEIGHT RANGE	REGENERATION TIME TO FORMER HEIGHT (YEARS)	LEVEL 1 – STANDARD ROW VEGETATION MANAGEMENT	LEVEL 2 – SELECTIVE ROW VEGETATION MANAGEMENT – WIRE-BORDER ZONE	LEVEL 3 – SELECTIVE ROW – CLEARANCE BASED VEGETATION MANAGEMENT
					ROW Border Zone – Managed for allowed vegetation, including shrub and tree types, heights and densities.
Mountain Shrubland SO46 - Gambel oak - Serviceberry - Mountain-mahogany - Chokecherry	8 to 15 feet	20 to 50 years	Construction Phase: Cleared from ROW. Operation Phase: ROW managed for low growing shrubs and herbs.	Construction Phase: *ROW Wire Zone* – Same as Level 1. Cleared from ROW *ROW Border Zone* - Selectively cleared based on allowed heights and densities. Most shrubs would be allowed in the border zone. Operation Phase: *ROW Wire Zone* - Same as Level 1. Managed for low growing shrubs and herbs. *ROW Border Zone* – managed for allowed shrub heights and densities.	Construction Phase: *ROW Wire Zone* - Selectively cleared based on allowed heights and densities. Most shrubs would be allowed in the wire zone, except along access roads and structure clearance sites. *ROW Border Zone* - Selectively cleared based on allowed heights and densities. Most shrubs would be allowed in the border zone, except along access roads and structure clearance sites. Operation Phase: *ROW Wire Zone* - Managed for allowed vegetation, including shrub types, heights and densities.

TABLE C-1 TWE PROJECT DEIS VEGETATION MANGEMENT GUIDELINES BY VEGETATION LAND COVER TYPE RESPONSE TO AECOM DECEMBER 10, 2010 DATA REQUEST NUMBER 15					
VEGETATION LAND COVER TYPE/ AND DOMINANT SPECIES*	HEIGHT RANGE	REGENERATION TIME TO FORMER HEIGHT (YEARS)	LEVEL 1 – STANDARD ROW VEGETATION MANAGEMENT	LEVEL 2 – SELECTIVE ROW VEGETATION MANAGEMENT – WIRE-BORDER ZONE	LEVEL 3 – SELECTIVE ROW – CLEARANCE BASED VEGETATION MANAGEMENT
					ROW Border Zone – Managed for allowed vegetation, including shrub types, heights and densities.
Sagebrush Shrubland SO54, SO55, SO56 - Big sagebrush - Silver sagebrush - Black sagebrush	2 to 6 feet tall	20 to 50 years	Construction Phase: Retained in ROW except where fuel load is too great; and along access roads and construction sites. Operation Phase: ROW managed for low growing shrubs and herbs.	NOT APPLICABLE	NOT APPLICABLE
Desert Shrubland SO45, SO60, SO65, SO69 Cold Desert: - Greasewood - Rabbitbrush - Saltbush species Warm Desert: - Creosote bush - Burro bush - Josha trees	1 to 6 feet tall Josha trees – 20 feet; Salt bush – less than 1 foot; Average – 3 feet	Cold desert: 30 to 50 years Warm desert: 50 to 200 years	Construction Phase: Retained in ROW except where fuel load is too great; and along access roads and construction sites. Joshua trees would be retained, except for center span of wire zone. Operation Phase: ROW managed for low growing shrubs and herbs. Joshua trees would be retained, except for center span of wire zone.	NOT APPLICABLE	NOT APPLICABLE

TABLE C-1 TWE PROJECT DEIS VEGETATION MANGEMENT GUIDELINES BY VEGETATION LAND COVER TYPE
RESPONSE TO AECOM DECEMBER 10, 2010 DATA REQUEST NUMBER 15

VEGETATION LAND COVER TYPE/ AND DOMINANT SPECIES*	HEIGHT RANGE	REGENERATION TIME TO FORMER HEIGHT (YEARS)	LEVEL 1 – STANDARD ROW VEGETATION MANAGEMENT	LEVEL 2 – SELECTIVE ROW VEGETATION MANAGEMENT – WIRE-BORDER ZONE	LEVEL 3 – SELECTIVE ROW – CLEARANCE BASED VEGETATION MANAGEMENT
Riparian SO96, S118 - Cottonwoods - Willows - River birch - Boxelder - Willow	Trees – 30 to 60 feet (if present) Shrubs – 5 to 15 feet	Trees – 50 to 80 years Shrubs – 5 to 20 years	NOT APPLICABLE	NOT APPLICABLE	Construction Phase: Retained in ROW except where fuel load is too great; or where conductor clearances cannot be maintained. Riparian areas would be avoided by access roads and construction sites to the extent feasible. Trees would be retained, except for center span of wire zone. *<u>ROW Wire Zone and Border Zone -</u>* Selectively cleared based on allowed vegetation types, heights and densities. Operation Phase: *<u>ROW Wire Zone and Border Zone -</u>* Managed for compatible vegetation, including trees, shrubs and herbs, based on allowed types, heights and densities.
Wetland SO96 - Greasewood - Saltbush	2 to 5 feet	20 to 40 years	NOT APPLICABLE	NOT APPLICABLE	Construction Phase: Retained in ROW except where impacts are unavoidable (e.g. limited

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- Inland salt grass - Alkali sacaton					access roads). Operation Phase: Managed for retention of compatible vegetation.
Grassland/Steppe SO71, SO79, SO90 - Herbs and Shrubs	Herbs – 1 to 2 feet Shrubs – 1 to 5 feet	5 to 20 years	Construction Phase: Retained in ROW. Operation Phase: ROW managed for low growing shrubs and herbs.	NOT APPLICABLE	NOT APPLICABLE
Grassland – Invasive D08 - Cheatgrass - Red brome	Herbs – 1 to 2 feet	1 to 2 years	Construction Phase: Cleared from ROW. Operation Phase: ROW managed for non-invasive low growing shrubs and herbs.	NOT APPLICABLE	NOT APPLICABLE
Riparian – Invasive D04 - Tamarisk	5 to 20 feet	5 to 20 years	Construction Phase: Cleared from ROW. Operation Phase: ROW managed for non-invasive low growing shrub species.	NOT APPLICABLE	NOT APPLICABLE

* Land cover types and dominant species listing is based on AECOM's Memorandum: Characteristics of Land Cover Crossed by TransWest Transmission Project Alternative Corridors, Draft, February 22, 2011.

Level 3 - Typical ROW Setting

Level 3 – ROW with Elevated Line Setting

FIGURE C-1 PHOTOGRAPHS OF LEVEL 3 VEGETATION MANAGEMENT

APPENDIX D

Supplemental Information - Technical Information of Applicability of Induced Current Risks for AC and DC Transmission Lines

APPLICABILITY OF INDUCED CURRENT RISKS FOR AC AND DC TRANSMISSION LINES

The proposed TWE Project ±600 kV DC transmission line presents no risk of inducing line currents due to the static nature of the DC electrical and magnetic fields. In comparison, AC transmission systems can induce currents. Mitigation measures for AC inductive currents would be implemented for the AC transmission lines associated with the Proposed TWE Project or for System Alternatives 2 and 3.

In order to mitigate possible electric shock caused by electrostatic and electromagnetic AC induction, all buildings, fences, and other structures with metal surfaces located within 300 feet of the centerline of the ROW will be grounded to the mutual satisfaction of the parties involved. Typically, residential buildings located 300 feet from the centerline will not require grounding. Other buildings or structures outside of the ROW will be reviewed in accordance with NESC to determine grounding requirements. All metal irrigation systems and fences that parallel the transmission line for distances of 500 feet or more, within 300 feet of the centerline will be grounded. All fences that cross under the transmission line also will need to be grounded. This procedure will be included in the construction specifications, and if grounding is required outside the ROW, agency and landowner consent will be obtained as necessary.

AC Inductive Mitigation for Railroads

When a high voltage transmission line is located adjacent to a railroad, the tracks and signals may be subjected to electrical interference from electric and magnetic induction, conductive interference, and capacitive effects. Capacitive coupling results from the electric field from the transmission lines' conductors coupling with above ground conductive objects that are insulated from the earth, such as railroad tracks that are typically installed on high impedance ballast (the rock bed used to support the tracks). Electric and magnetic induction results from the magnetic field produced by the alternating current (AC) flowing in the conductors of the transmission line coupling with the above ground and below ground metallic objects, such as railroad tracks and buried communications cables, if present. If a transmission line is located in proximity and parallel to a railroad for long distances, all these interference mechanisms can cause high currents and voltages to develop on the tracks and communication cables. If the AC interference is above certain thresholds, it can result in personal safety hazards, damage to signal and communication equipment, and false signaling of equipment.

These AC interference effects can be predicted with computer modeling. With proper planning and mitigation management, railroads and high voltage AC transmission lines can be safely collocated. The American Railway Engineering and Maintenance-of-Way Association has specifications for steady state rail-to-ground and equipment-to-ground voltage levels to ensure safety of railway operating personnel and the public. During fault conditions the safety criteria established by the ANSI/IEEE Standard 80 (Guide for Safety in AC Substation Grounding) is used. In addition, railroad signal and equipment manufacturers provide AC interference voltage tolerances for proper signal operation so that nearby transmission facilities can be designed to ensure that AC interference levels do not exceed the acceptable safety criteria or equipment voltage tolerance.

Depending on AC interference levels, several mitigation methods may be used. These include increasing the distance between the transmission line and the railroad tracks, reducing the distance between insulated joints in track sections, grounding the railroad's tracks, and burying gradient control wires or matting.

For locations where the final alignment of an AC section of transmission line is in close proximity to a railroad for long distances, the Applicant, during detailed design, would perform computer modeling of potential AC interference effects to design and implement required mitigation to be installed prior to energizing the transmission line.

AC Inductive Mitigation for Pipelines

When a high voltage transmission line is located adjacent to a pipeline ROW, the pipeline may be subjected to electrical interference from electric and magnetic induction, conductive interference, and capacitive effects. Electric and magnetic induction is the primary effect of the high voltage AC transmission line on a buried pipeline during normal (steady-state) operation. This form of interference is due to the magnetic field produced by the AC current flowing in the conductors of the transmission line coupling with the metallic pipeline, inducing a voltage and associated current on the pipeline.

Conductive interference is a concern when a transmission line fault occurs in proximity to the pipeline, because it can cause AC currents to enter the pipeline at coating holidays (flaws in the coating) and produce a voltage gradient across the pipeline coating. Electric and magnetic effects are also a concern during a fault because the phase current in at least one phase (conductor) of the high voltage AC transmission line is elevated.

If these electrical interference effects are great enough during normal operation, then a potential shock hazard exists for anyone that touches an above ground part of the pipeline, such as a valve or cathodic protection test station. In addition, during normal operation, if the induced AC current density at a flaw in the pipeline coating is great enough, AC pipeline corrosion may occur. Lastly, damage to the pipeline coating can occur if the voltage between the pipeline and surrounding soil becomes excessive during a fault condition.

With proper planning and mitigation, pipelines and high voltage AC transmission lines can be safely collocated. The AC interference effects can be easily predicted with computer modeling. The National Association of Corrosion Engineers has standards that ensure that pipeline integrity would not be degraded nor personnel safety compromised because of AC interference from a transmission line constructed and operated adjacent to a pipeline.

Mitigation techniques for AC interference on pipelines include reducing the impedance of the transmission structure grounds, grounding the pipeline in conjunction with de-couplers, burying gradient control wires along the pipeline or burying ground mats under aboveground facilities (such as valves) and using dead fronts at test stations.

The TWE Project configured as an overhead AC transmission line can be located in its 250 foot ROW adjacent to the ROW for buried underground high pressure natural gas and other petroleum pipelines as long as proper grounding and cathodic protection systems are utilized for the pipeline. The TWE Project; however, may not be sited in the same ROW as an underground pipeline regardless of whether the TWE Project is a DC or AC line. For locations where the final alignment of an AC section of transmission line is in close proximity to a pipeline, the Applicant, during detailed design, would ensure that computer modeling of AC interference effects is completed and that any required mitigation is designed and installed prior to energizing the transmission line.